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Model Q3-30
Thermal Printer
Technical Manual A0008-01118A

Computer Devices Inc.
O. E. M. Products Group
25 North Avenue
Burlington, MA. 01803

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Continued from page 10
of the report
dated 11/11/64
Burlington, MA 01803

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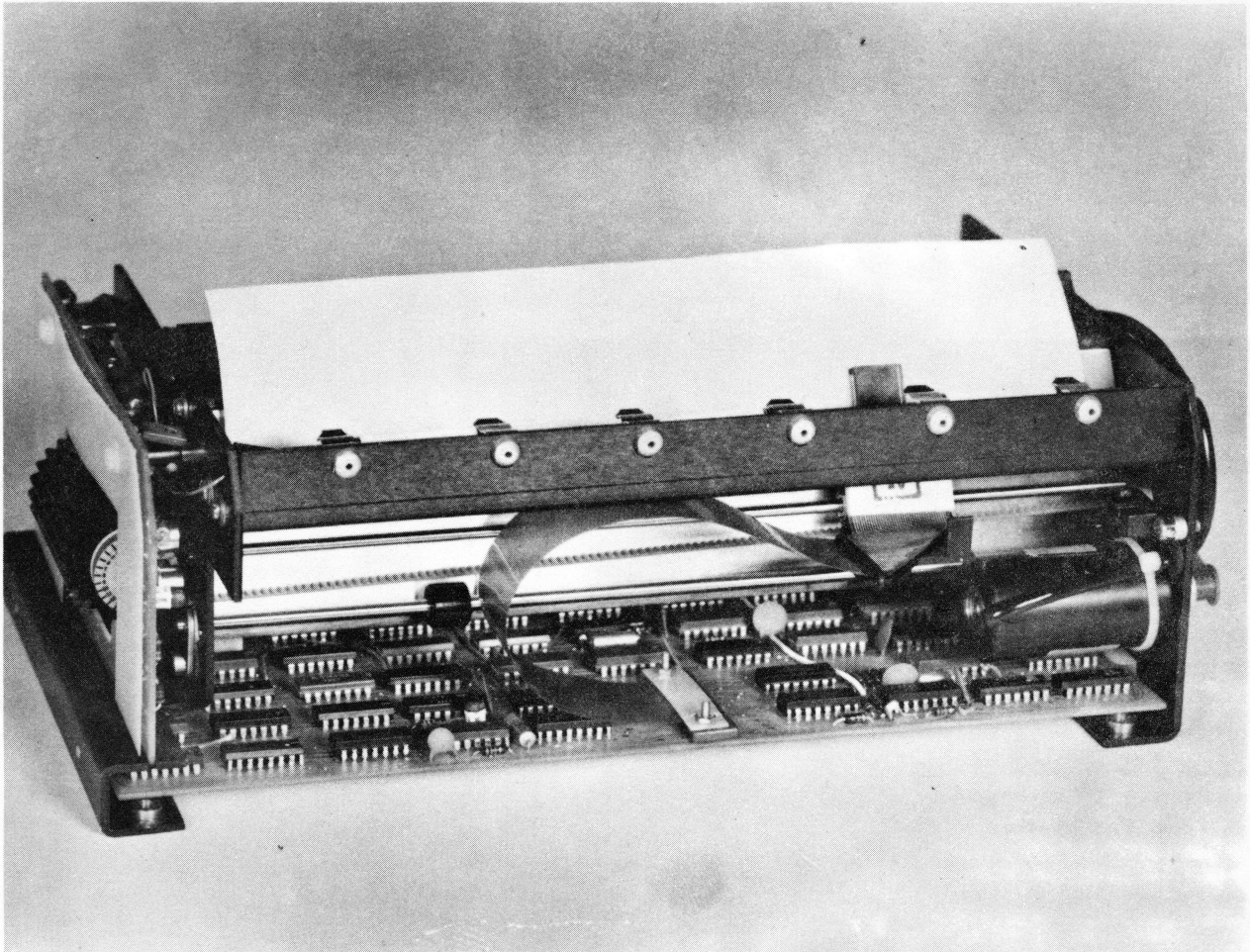


Figure 1-1. CDI Q3-30 Data Printer

SECTION 1

GENERAL CHARACTERISTICS

1-1. GENERAL DESCRIPTION.

The CDI Q3-30 Data Printer (Figure 1-1) is a 30 character per second, friction feed, thermal paper printer. The printer character fonts available provide for upper and lower case, APL and dual character sets. The 5 x 7 dot matrix print head is temperature compensated to maintain a constant print density for the varying operating temperatures and print speeds. The printer is furnished with automatic carriage return and line feed at the 81st column. The carriage return time is less than 200 milliseconds.

1-2. PRINTING PAPER.

The printer chassis has the capacity for mounting a 2 1/2 inch diameter roll of thermal printing paper. Each roll of thermal printing paper is 8 3/4 inches wide with a length of 100 feet providing a total print capability of 7200 lines. The last 10 feet of the printing paper roll is color-coded to indicate when a replacement roll is required. Installation of the replacement roll should be performed in accordance with the procedure detailed in paragraph 2-2. In addition, the printer is equipped with an out-of-paper microswitch which provides an out-of-paper indication to a terminal or other remote location and stops printer operation.

CAUTION

Only paper supplied by Computer Devices Inc. should be used. Use of paper other than that specified may cause damage to the printing element and void the warranty.

1-3. GENERAL PHYSICAL CHARACTERISTICS AND OPERATING ENVIRONMENT.

The significant physical characteristics of the printer and its required operating and storage environments are listed in Table 1-1.

1-4. CAPABILITIES AND LIMITATIONS.

The capabilities and limitations of the printer are provided in Table 1-2.

1-5. POWER REQUIREMENTS.

Table 1-3 indicates the printer input power requirements.

Table 1-1. General Physical Characteristics and Operational Environment.

<u>Item</u>	<u>Parameter</u>
Weight (max)	4.25 lbs excluding paper roll
Overall dimensions	
Height	3.65 inches
Width	11.4 inches
Depth	5.83 inches
Print paper capacity	2 1/4 in. -diameter roll (100' x 8 3/4")
Ambient temperature	
Operating	0° to 50°C (32° to 122°F)
Storage (excluding paper)	-40° to 70°C (-40° to 158°F)
Humidity	
Operating	10% to 90% non condensing
Storage	10% to 90% non condensing
Shock	
Operating	0.1g
Storage and handling	10g
Vibration	10 to 60Hz
	0.1g

Table 1-2. Printing Characteristics

<u>Characteristic</u>	<u>Parameter</u>
Paper Feed	60 lines/sec (Friction Feed)
Line Length	80 characters (8 inches)
Line density	6 lines/inch
Character spacing	10 characters/inch
Print rate	30 characters/sec
STD fonts	96 characters and 188 dual font
Code	ASCII
	APL
	Selectric
	Kata Kana
	USASC II
	IBM Correspondence
	IBM EBCD
Carriage return time	< 200 MS

Table 1-3. Power Requirements

Voltage	+5.0Vdc	+17.0Vdc	-24.0VDC	+24.0Vdc
Max. Peak Current (amp)	1.5	3.1	.150	2.2
Avg. Oper. Current (amp)	1.3	1.5	.120	1.9
Standby Current (amp)	1.3	1.0	.120	.1
Regulation (%)	± 2	± 2	± 5	± 5
Allowable Ripple (p-p)	40 mv	100 mv	40 mv	500 mv

SECTION 2

INSTALLATION

2-1. PRINTER INSTALLATION.

Installation of the CDI Q3-30 data printer in the selected terminal requires no special tools or equipment. The recipient terminal must have adequate clearance space as indicated in Figure 2-1. The CDI Q3-30 printer

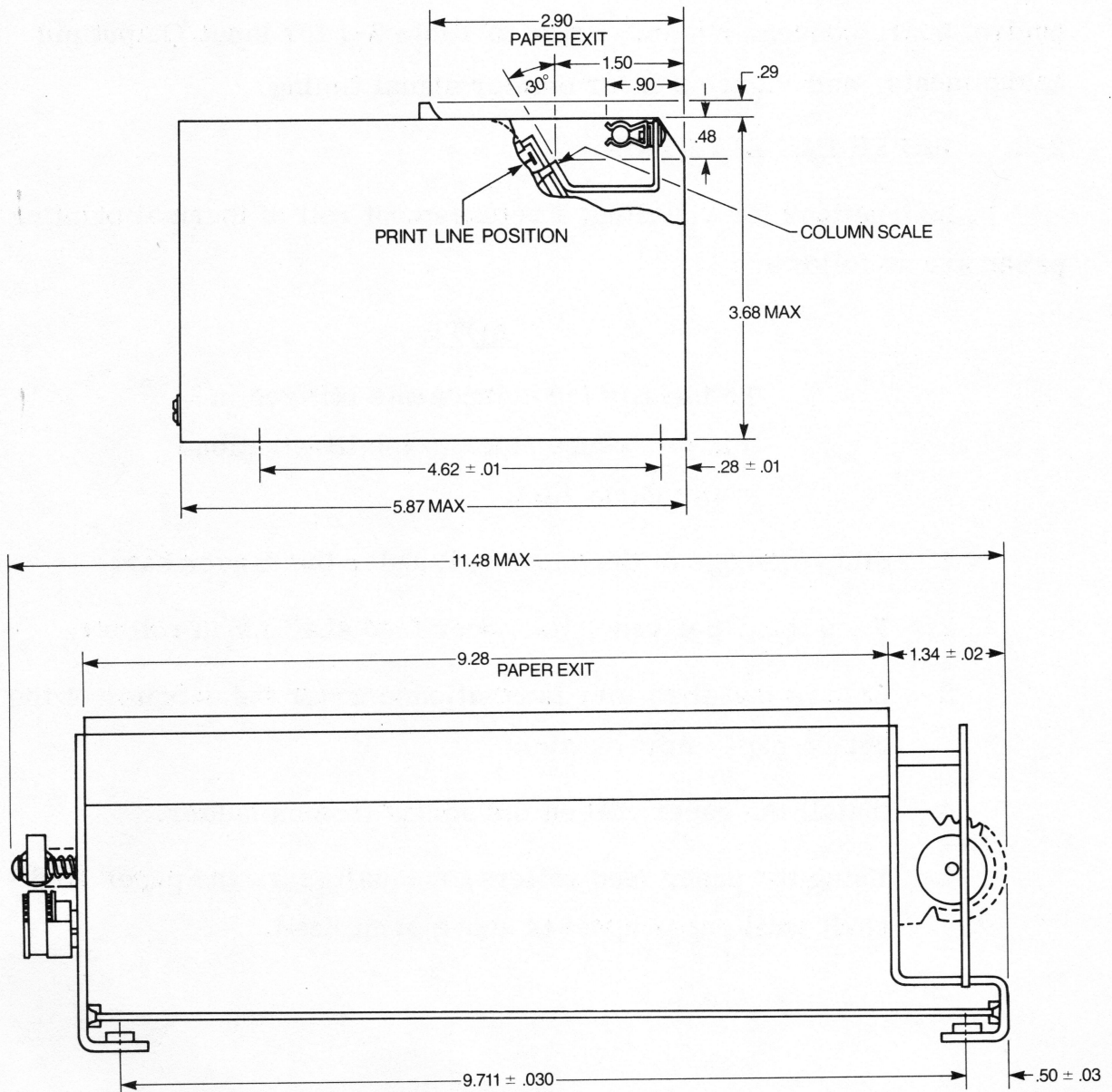


Figure 2-1. Printer Physical Parameters

is secured to the terminal using four (4) No. 8 screws with a 3/16 inch maximum thread length. If the terminal is not shock mounted it is recommended for noise reduction that the printer be installed utilizing shoulder screws with Barry Shock Mounts (No. 275-5). However, the use of shock mounts requires an additional 7/16 inch clearance in terminal depth.

Power and signal interface is accomplished by connecting a 22 pin dual readout socket (Cinch No. 50-44A-30 or equivalent) to the printer control board connector pins. Refer to Table 2-1 for Input/Output pin assignments, and Figure 2-2 for printer signal timing.

2-2. PAPER INSTALLATION.

Instructions for installing a replacement roll of thermal printing paper are as follows:

NOTE

To identify the components utilized in this procedure refer to the illustrations in the Parts List.

1. Slide the edge of the paper roll under the dancer bar.
2. Feed the paper under the paper feed shaft pinch rollers.
3. Ensure that the paper is positioned under the actuator of the out-of-paper microswitch.
4. Install the paper roll on the spring tension holder.
5. Using the paper feed rollers, manually turn the paper feed shaft until paper appears above print head.

Table 2-1. Printer Control Board Connections
(Cinch 50-44A-30 or equivalent)

TO UNIT	SIGNAL	FROM UNIT	PIN NUMBER
Start Pulse			6
Data Bit 1			E
Data Bit 2			D
Data Bit 3			C
Data Bit 4			B
Data Bit 5			2
Data Bit 6			3
Data Bit 7			4
		Busy	17
		ROM BUSY	H
		700 KHz Clock	F
$\overline{S/O}$ (STD)			9
		S/I Indicator	N
$\overline{S/I}$ (ALT)			7
Case Reset			8
		$\overline{\text{Initialize}}$	10
		$\overline{\text{Paper Out}}$	16
Local C/R			R
Local LF			P
		$\overline{\text{Load}}$	U

Table 2-1. Printer Control Board Connections
(Cinch 50-44A-30 or equivalent) (Cont)

TO UNIT	SIGNAL	FROM UNIT	PIN NUMBER
		<u>Dn Cnt</u>	V
		<u>Up Cnt</u>	18
		C/R Mtr Clk	15
	<u>Ext Mtr Clk</u>		S
	Ext Print Time Adj		T
	+5 volts		22 and Z
	Logic Gnd		21 and Y
	Chassis Gnd		1 and A
	Power Gnd		19 and W
	+24 Volts		11 and M
	+17 Volts		20 and X
	-24 Volts		L
	-12 Volts		5

NOTE

If the paper edge is not a smooth cut the paper may jam under the print head.

6. Manually turn the paper roll to take up any slack in the paper.

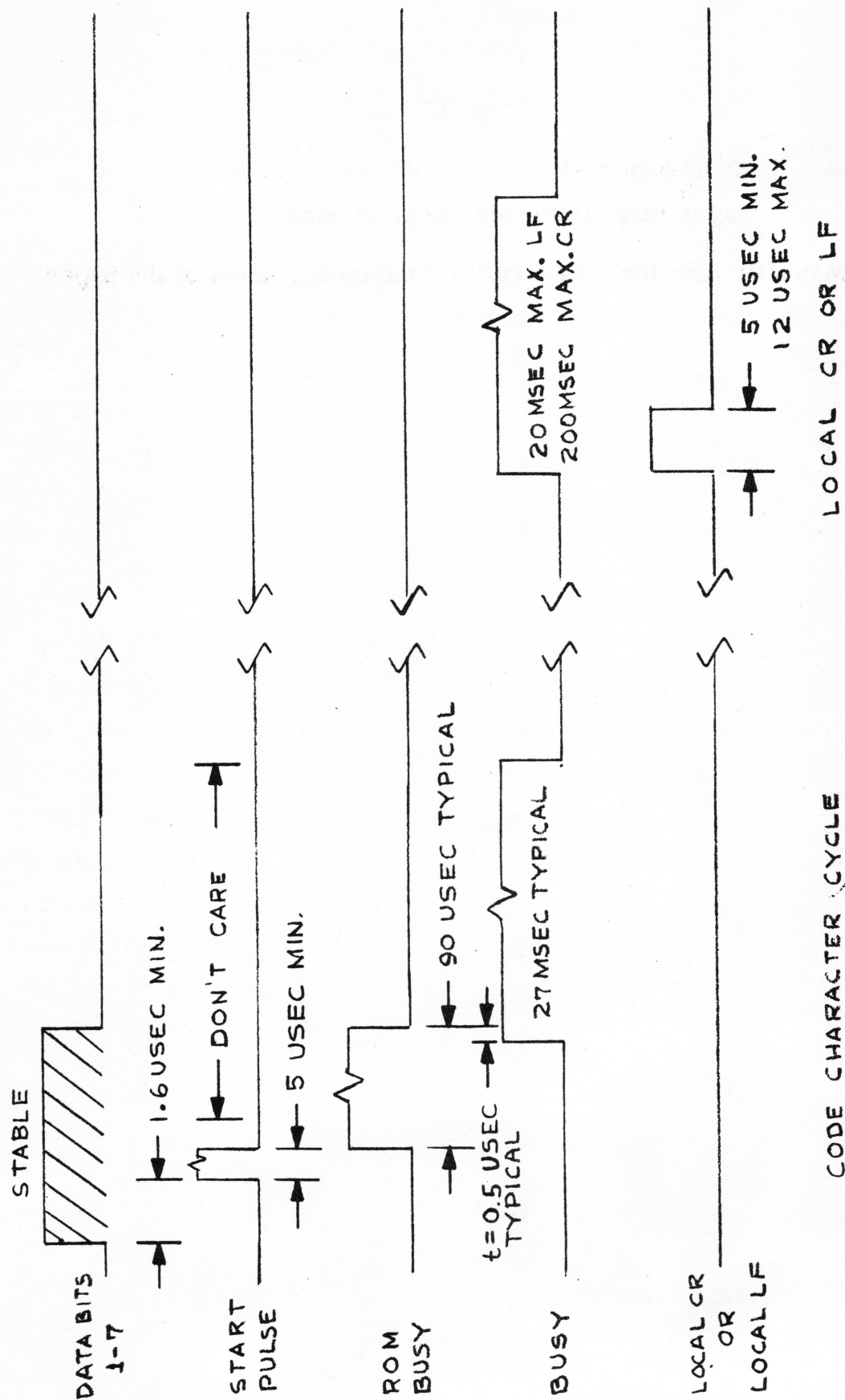


Figure 2-2. Printer Signal Timing

SECTION 3

OPERATIONAL ADJUSTMENT

3-1. INTRODUCTION

The CDI Q3-30 data printer does not require periodic adjustment to maintain optimum operating performance. However, for the repair or replacement of a component part the following operating adjustments are provided in this section.

1. Print Head Clearance Adjustment
2. First Character Alignment
3. Print Time Adjustment

The print head clearance adjustment (paragraph 3-2) is performed when improper carriage return or paper line feed operation is suspected. Misalignment of the first character (paragraph 3-3) is detected by observing if the print head column indicator aligns with the position 1 indicator on the lamp holder assembly when the carriage is in the home position. Radical misalignment results in the carriage colliding with the left or right hand side plate. If character print quality has deteriorated, the print time adjustment, (paragraph 3-4) should be performed. Symptoms of print character quality deterioration are blurring, ghosting, fading, or a complete loss of character.

3-2. PRINT HEAD CLEARANCE ADJUSTMENT.

Tools Required:

- a. Feeler gauge
- b. Slot head screwdriver

1. Disconnect signal/power connector from print control board or remove power from terminal.
2. Remove the two (2) nylon screws securing the driver printed circuit board to the right hand side plate.
3. Remove the board from the socket and place at rear of the printer. Care should be used in removing the board to prevent damage to the wiring and components.
4. Loosen the four (4) screws securing the lamp holder assembly to the left hand and right hand side plates.
5. Verify that the paper is installed in the printer.
6. Slide the print head to the extreme left (home) position.
7. Insert feeler gauge between the lamp holder assembly and print head and adjust the lamp holder assembly for a gap of 0.010 inches.

CAUTION

When adjusting lamp holder assembly the lamp holder assembly must be maintained level and flush against lamp holder support surface. This is done by pressing down firmly on lamp holder assembly with thumb and index finger.

8. Slide the print head to the extreme right hand position and repeat adjustment.
9. Holding the lamp holder assembly securely in place, tighten the four (4) lamp holder assembly screws.
10. Verify the lamp holder assembly alignment by checking print head clearance at various points along the entire length of the assembly.
11. Install the driver printed circuit board and secure in place with the two (2) nylon screws.
12. For print head dot-location, refer to Figure 3-1, page 3-7.

3-3. FIRST CHARACTER ALIGNMENT

Equipment required:

- a. Scale graduated in 0.001
1. Verify carriage is at home position (1st character).
 - a. Remove carriage return belt.
 - b. Initiate carriage return.
 - c. Place flag in photocell.
 - d. Replace belt on the carriage with print head indicator at approximately 1st column.
 2. Measure the distance between the left hand side plate and the center line of the column indicator on print head. Record this value.
 3. Deenergize printer.

4. Note the stepping motor pulley tooth number at which the carriage belt position line (inscribed on belt) is located. Record this number.
5. Using table 3-1, locate the intersection of the column indicator measurement and the stepping motor pulley tooth number recorded in steps 3 and 4 respectively. Record the number indicated in the table.

NOTE

This number is the new stepping motor pulley tooth that the carriage belt position indicator must be aligned with to provide for alignment of 1st character.

6. Depress the pulley tension device located on left hand side plate to loosen carriage belt for repositioning.
7. With the pulley tension device depressed align the carriage belt position indicator with the tooth number recorded in step 5.
8. Energize the printer.
9. Test the first character alignment and repeat adjustment if necessary.

3-4. PRINT TIME ADJUSTMENT

NOTE

This adjustment is performed with a print rate of 30 characters per second and the print mechanism at a temperature between 25°C and 35°C, also for printers which have been optimized for type "B" thermal paper.

Tooth That Carriage Belt Position Indicator is Located

Table 3-1. Head Position Table
Distance From Left Hand Side Plate To Print Head Column Indicator

	.466	.479	.493	.507	.520	.534	.547	.561	.575	.589	.602	.616	.629	.643	.656	.669	.683	.696	.710	.723	.737	.751	.765	.778	.792	.805	.819	.833	.846
1	13	8	3	27	22	17	12	7	2	26	21	16	11	6		25	20	15	10	5	29	24	19	14	9	4	28	23	18
2	14	9	4	28	23	18	13	8	3	27	22	17	12	7		26	21	16	11	6	1	25	20	15	10	5	29	24	19
3	15	10	5	29	24	19	14	9	4	28	23	18	13	8		27	22	17	12	7	2	26	21	16	11	6	1	25	20
4	16	11	6	1	25	20	15	10	5	29	24	19	14	9		28	23	18	13	8	3	27	22	17	12	7	2	26	21
5	17	12	7	2	26	21	16	11	6	1	25	20	15	10		29	24	19	14	9	4	28	23	18	13	8	3	27	22
6	18	13	8	3	27	22	17	12	7	2	26	21	16	11		1	25	20	15	10	5	29	24	19	14	9	4	28	23
7	19	14	9	4	28	23	18	13	8	3	27	22	17	12		2	26	21	16	11	6	1	25	20	15	10	5	29	24
8	20	15	10	5	29	24	19	14	9	4	28	23	18	13		3	27	22	17	12	7	2	26	21	16	11	6	1	25
9	21	16	11	6	1	25	20	15	10	5	29	24	19	14		4	28	23	18	13	8	3	27	22	17	12	7	2	26
10	22	17	12	7	2	26	21	16	11	6	1	25	20	15		5	29	24	19	14	9	4	28	23	18	13	8	3	27
11	23	18	13	8	3	27	22	17	12	7	2	26	21	16		6	1	25	20	15	10	5	29	24	19	14	9	4	28
12	24	19	14	9	4	28	23	18	13	8	3	27	22	17		7	2	26	21	16	11	6	1	25	20	15	10	5	29
13	25	20	15	10	5	29	24	19	14	9	4	28	23	18		8	3	27	22	17	12	7	2	26	21	16	11	6	1
14	26	21	16	11	6	1	25	20	15	10	5	29	24	19		9	4	28	23	18	13	8	3	27	22	17	12	7	2
15	27	22	17	12	7	2	26	21	16	11	6	1	25	20		10	5	29	24	19	14	9	4	28	23	18	13	8	3
16	28	23	18	13	8	3	27	22	17	12	7	2	26	21		11	6	1	25	20	15	10	5	29	24	19	14	9	4
17	29	24	19	14	9	4	28	23	18	13	8	3	27	22		12	7	2	26	21	16	11	6	1	25	20	15	10	5
18	1	25	20	15	10	5	29	24	19	14	9	4	28	23		13	8	3	27	22	17	12	7	2	26	21	16	11	6
19	2	26	21	16	11	6	1	25	20	15	10	5	29	24		14	9	4	28	23	18	13	8	3	27	22	17	12	7
20	3	27	22	17	12	7	2	26	21	16	11	6	1	25		15	10	5	29	24	19	14	9	4	28	23	18	13	8
21	4	28	23	18	13	8	3	27	22	17	12	7	2	26		16	11	6	1	25	20	15	10	5	29	24	19	14	9
22	5	29	24	19	14	9	4	28	23	18	13	8	3	27		17	12	7	2	26	21	16	11	6	1	25	20	15	10
23	6	1	25	20	15	10	5	29	24	19	14	9	4	28		18	13	8	3	27	22	17	12	7	2	26	21	16	11
24	7	2	26	21	16	11	6	1	25	20	15	10	5	29		19	14	9	4	28	23	18	13	8	3	27	22	17	12
25	8	3	27	22	17	12	7	2	26	21	16	11	6	1		20	15	10	5	29	24	19	14	9	4	28	23	18	13
26	9	4	28	23	18	13	8	3	27	22	17	12	7	2		21	16	11	6	1	25	20	15	10	5	29	24	19	14
27	10	5	29	24	19	14	9	4	28	23	18	13	8	3		22	17	12	7	2	26	21	16	11	6	1	25	20	15
28	11	6	1	25	20	15	10	5	29	24	19	14	9	4		23	18	13	8	3	27	22	17	12	7	2	26	21	16
29	12	7	2	26	21	16	11	6	1	25	20	15	10	5		24	19	14	9	4	28	23	18	13	8	3	27	22	17

Equipment required:

- a. Oscilloscope
 - b. Non metallic adjustment tool
1. Connect oscilloscope to print head connector stud test point.
This stud is located at the extreme front of the printer control board directly below the lamp holder assembly.
 2. Adjust the red finger potentiometer R38, while observing print quality, to center scale as indicated by the arrow on the printer control board.

NOTE

Potentiometer is located at rear of unit and mounted on under side of print control board.

3. Energize the printer and establish a print rate of 30 characters / sec.
4. Adjust trim potentiometer R50 (potentiometer at rear of printer as viewed from top) for a print time saturation pulse width of 8.5 ± 0.1 milliseconds as viewed on the oscilloscope and illustrated in Figure 3-1.

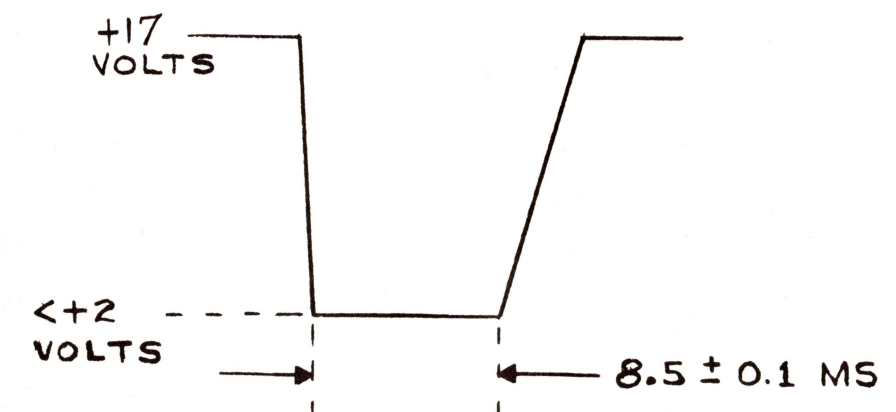
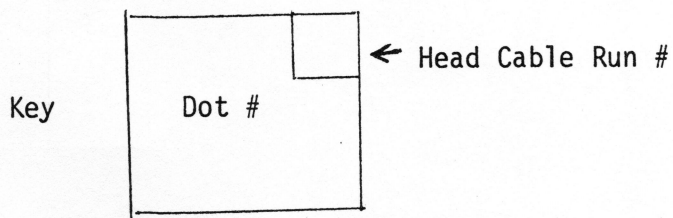


Figure 3-1. Print Time Saturation Pulse

Dot 1	39	Dot 8	38	Dot 15	37	Dot 22	36	Dot 29	35
Dot 2	30	Dot 9	31	Dot 16	32	Dot 23	33	Dot 30	34
Dot 3	29	Dot 10	28	Dot 17	27	Dot 24	26	Dot 31	25
Dot 4	20	Dot 11	21	Dot 18	22	Dot 25	23	Dot 32	24
Dot 5	19	Dot 12	18	Dot 19	17	Dot 26	16	Dot 33	15
Dot 6	8	Dot 13	9	Dot 20	10	Dot 27	11	Dot 34	12
Dot 7	7	Dot 14	6	Dot 21	5	Dot 28	4	Dot 35	3

DOTS AS VIEWED WHEN PRINTED



PRINT HEAD - DOT LOCATION

Figure 3-1



SECTION 4

TECHNICAL DISCUSSION

4-1. INTRODUCTION

This technical discussion consists of a block diagram description and a detailed functional description of the printer. The block diagram description provides a basic functional description of the printer. Circuit detail is provided in the detailed functional description.

4-2. BLOCK DIAGRAM DESCRIPTION

A block diagram of the printer illustrating its major functional sections is shown in figure 4-1. All of the electronic circuitry is contained on two printed circuit boards. The carriage motor, the line feed motor, the force motor, and the print head are part of the print mechanism. All of the inputs and outputs excluding power are at TTL compatible levels and all are routed in and out on the single interface connector.

4-2.1. Initialization. In order to prepare the circuits for execution of input commands after application of power, an initialization signal (INIT) is generated by the initialize circuit and distributed to several sections of the printer. In the carriage return circuitry, the signal causes a carriage return and in the line feed circuitry, a line feed. In the print control circuit, the signal resets the logic circuits to the quiescent state. An output from the initialize circuit is also routed to the character generator and function decode circuits to ensure that those circuits are in the quiescent state with the unit reset to lower case and alternate ROM. The complement of the initialize pulse is available at the interface connector for external use.

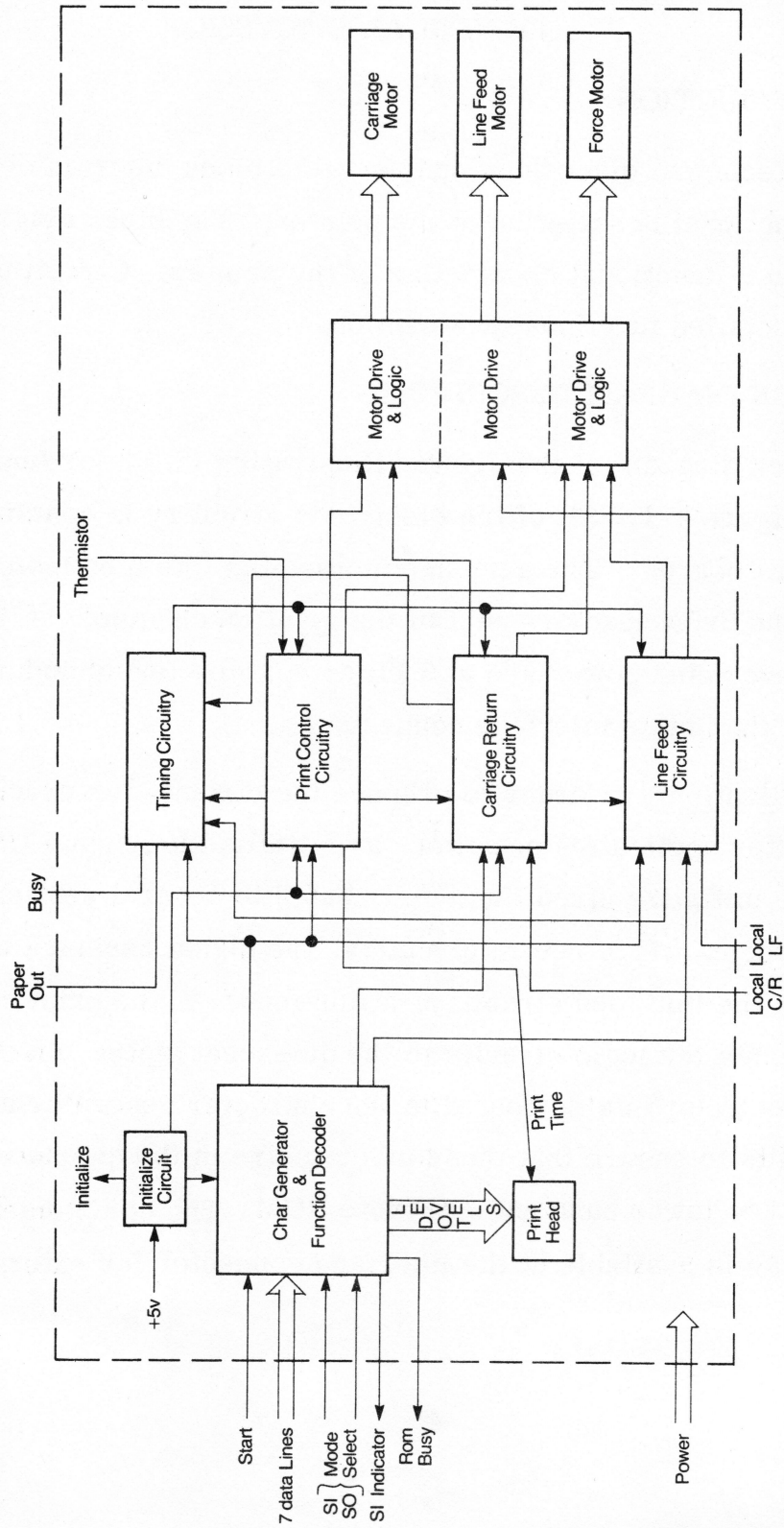


Figure 4-1. Printer Functional Block Diagram

After the printer circuits are in a condition to respond to inputs, logic low ROM BUSY and BUSY signals are provided at the interface connector. The ROM BUSY signal is placed at a logic high level to denote that the character generator and function decoder section is busy processing the input code. The BUSY signal output is set to a logic high level whenever a character print cycle, line feed cycle, or carriage return cycle is in process or if the printer is out of paper. A PAPER OUT signal is also available at the interface connector in the complement form; that is, a logic low level indicates that the paper supply is exhausted.

4-2.2. Character Decoding. Execution of commands is accomplished by placing one of several types of character codes on the data line inputs and applying a START pulse to the character generator and function decoder section. The data lines provide partial addresses to two ROM's. Each ROM is programmed to provide one of the standard character sets shown on figures 4-2 through 4-5. Other character sets are possible by interchanging suitably programmed ROM's. Selection of one of the two installed ROM's is controlled by the mode select inputs to the character generator and function decoder section. The SI (shift in) line selects the ROM designated as the alternate ROM and the SO (shift out) line selects the ROM designated at the standard ROM. The SI indicator output denotes the SI ROM is enabled.

The START pulse initiates operation of a timing sequence within the character generator and function decoder section that provides the remainder of the ROM addresses. For each character code placed on the DATA LINES, the ROM in use is addressed nine times during the timing sequence. Each time a new address is provided, a five bit word is read out and stored in a

B I T S	b7 →				0	0	0	0	1	1	1	1	
	b6 →				0	0	1	1	0	0	1	1	
	b5 →				0	1	0	1	0	1	0	1	
	b4 ↓	b3 ↓	b2 ↓	b1 ↓	COLUMN ROW	0	1	2	3	4	5	6	7
	0	0	0	0	0	NUL	DLE	SP	0	+	*	+	P
	0	0	0	1	1	SOH	DC1	"	1	α	?	A	Q
	0	0	1	0	2	STX	DC2	-	2	ι	ρ	B	R
	0	0	1	1	3	ETX	DC3	<	3	η	[	C	S
	0	1	0	0	4	EOT	DC4	≤	4	ι	~	D	T
	0	1	0	1	5	ENQ	NAK	=	5	ε	+	E	U
	0	1	1	0	6	ACK	SYN	≥	6	-	υ	F	V
	0	1	1	1	7	BEL	ETB	>	7	∇	ω	G	W
	1	0	0	0	8	BS	CAN	*	8	Δ	∃	H	X
	1	0	0	1	9	HT	EM	∇	9	ι	+	I	Y
	1	0	1	0	10	LF	SUB	)	]	ο	c	J	Z
	1	0	1	1	11	VT	ESC	(	[	'	┌	K	└
	1	1	0	0	12	FF	FS	.	:	□	◇	L	\$
	1	1	0	1	13	CR	GS	+	-		{	M	}
	1	1	1	0	14	SO	RS	.	:	τ	×	N	‡
	1	1	1	1	15	SI	US	/	\	ο	Λ	O	DEL

LEGEND

NUL	Null	DLE	Data Link Escape
SOH	Start of Heading	DC1	X-ON
STX	Start of Text	DC2	Tape
ETX	End of Text	DC3	X-OFF
EOT	End of Transmission	DC4	Tape
ENQ	Enquiry	NAK	Negative Acknowledge
ACK	Acknowledge	SYN	Synchronous Idle
BEL	Bell (audible or attention signal)	ETB	End of Transmission Block
BS	Backspace	CAN	Cancel
HT	Horizontal Tabulation (punched card skip)	EM	End of Medium
LF	Line Feed	SUB	Substitute
VT	Vertical Tabulation	ESC	Escape
FF	Form Feed	FS	File Separator
CR	Carriage Return	GS	Group Separator
SO	Shift Out	RS	Record Separator
SI	Shift In	US	Unit Separator
		≡	Delete

Figure 4-2. APL-A Character Set Code and Format

APL CHARACTER SET EBCD CODE

						LOWER CASE				UPPER CASE			
B I T S	b6 →					0	0	1	1	0	0	1	1
	b5 →					0	1	0	1	0	1	0	1
	b4 ↓	b3 ↓	b2 ↓	b1 ↓	COLUMN ROW ↓	0	1	2	3	0	1	2	3
	↓	↓	↓	↓	↓								
	0	0	0	0	0	SP	+	+	x	SP	+	-	±
	0	0	0	1	1	1	/	/	A	"	\	°	α
	0	0	1	0	2	2	S	K	H	-		'	↓
	0	0	1	1	3	3	T	L	C	<	~	□	∞
	0	1	0	0	4	4	U	M	D	\$	+		l
	0	1	0	1	5	5	V	N	E	=	u	τ	ε
	0	1	1	0	6	6	W	O	F	≥	ω	o	-
	0	1	1	1	7	7	X	P	G	>	∞	*	∇
	1	0	0	0	8	8	Y	Q	H	≠	†	?	Δ
	1	0	0	1	9	9	Z	R	I	v	<	ρ	ι
	1	0	1	0	10	0				^			
	1	0	1	1	11	J	,	l	.	)	:	(	:
	1	1	0	0	12								
	1	1	0	1	13		LF	CR	TAB		LF	CR	TAB
	1	1	1	0	14	UC		BS	LC	UC		BS	LC
	1	1	1	1	15	EOT		IDL		EOT		IDL	

LEGEND

SP	Space
UC	Upper Case
EOT	End of Transmission
LF	Line Feed
CR	New Line
BS	Backspace
IDL	Idle
TAB	Horizontal Tab
LC	Lower Case

Figure 4-3. APL-B Character Set Code and Format

USA STANDARD CODE FOR INFORMATION INTERCHANGE

BITS	b7 b6 b5 b4				COLUMN ROW	0	0	0	0	1	1	1	1
	b3	b2	b1			0	1	2	3	4	5	6	7
0	0	0	0	0	NUL	DLE	SP	0	@	P	\	p	
0	0	0	1	1	SOH	DC1	:	1	A	Q	a	q	
0	0	1	0	2	STX	DC2	"	2	B	R	b	r	
0	0	1	1	3	ETX	DC3	#	3	C	S	c	s	
0	1	0	0	4	EOT	DC4	\$	4	D	T	d	t	
0	1	0	1	5	ENQ	NAK	%	5	E	U	e	u	
0	1	1	0	6	ACK	SYN	&	6	F	V	f	v	
0	1	1	1	7	BEL	ETB	/	7	G	W	g	w	
1	0	0	0	8	BS	CAN	(	8	H	X	h	x	
1	0	0	1	9	HT	EM	)	9	I	Y	i	y	
1	0	1	0	10	LF	SUB	*	:	J	Z	j	z	
1	0	1	1	11	VT	ESC	+	;	K	[	k	{	
1	1	0	0	12	FF	FS	,	<	L	\	l		
1	1	0	1	13	CR	GS	-	=	M	]	m	}	
1	1	1	0	14	SO	RS	.	>	N	↑	n	~	
1	1	1	1	15	SI	US	/	?	0	←	o	≡	

LEGEND

NUL	Null	DLE	Data Link Escape
SOH	Start of Heading	DC1	X-ON
STX	Start of Text	DC2	Tape
ETX	End of Text	DC3	X-OFF
EOT	End of Transmission	DC4	Tape
ENQ	Enquiry	NAK	Negative Acknowledge
ACK	Acknowledge	SYN	Synchronous Idle
BEL	Bell (audible or attention signal)	ETB	End of Transmission Block
BS	Backspace	CAN	Cancel
HT	Horizontal Tabulation (punched card skip)	EM	End of Medium
LF	Line Feed	SUB	Substitute
VT	Vertical Tabulation	ESC	Escape
FF	Form Feed	FS	File Separator
CR	Carriage Return	GS	Group Separator
SO	Shift Out	RS	Record Separator
SI	Shift In	US	Unit Separator
		≡	Delete

Figure 4-4. ASCII Mode Character Set Code and Format

APL CHARACTER SET CORRESPONDENCE CODE

						LOWER CASE				UPPER CASE			
B I T S	b6					0	0	1	1	0	0	1	1
	b5					0	1	0	1	0	1	0	1
	b4	b3	b2	b1	COLUMN ROW	0	1	2	3	0	1	2	3
	0	0	0	0	0	SP	T	+	J	SP	~	+	o
	0	0	0	1	1	1	X	M	G	"	>		v
	0	0	1	0	2	2	N	.	x	-	T	:	‡
	0	0	1	1	3	3	U	V	F	<	+	u	-
	0	1	0	0	4	5	E	]	P	=	€	)	*
	0	1	0	1	5	7	D	R	[	>	L	p	(
	0	1	1	0	6	6	K	I	Q	≥	'	l	?
	0	1	1	1	7	8	C	A	,	*	n	a	:
	1	0	0	0	8	4	L	O	/	≤	□	o	\
	1	0	0	1	9	0	H	S	Y	^	Δ	f	†
	1	0	1	0	10	2				<			
	1	0	1	1	11	9	B	W	+	v	⊥	ω	-
	1	1	0	0	12								
	1	1	0	1	13		LF	CR	TAB		LF	CR	TAB
	1	1	1	0	14	UC		BS	LC	UC		BS	LC
	1	1	1	1	15	EOT		IDL		EOT		IDL	

TYPEWRITER CHARACTER SET CORRESPONDENCE CODE

2741 MODE

						LOWER CASE				UPPER CASE			
B I T S	b6					0	0	1	1	0	0	1	1
	b5					0	1	0	1	0	1	0	1
	b4	b3	b2	b1	COLUMN ROW	0	1	2	3	0	1	2	3
	0	0	0	0	0	SP	t	½	j	SP	T	½	J
	0	0	0	1	1	1	x	m	g	±	X	M	G
	0	0	1	0	2	2	n	.	=	@	N	..	+
	0	0	1	1	3	3	u	v	f	#	U	V	F
	0	1	0	0	4	5	e	'	p	%	E	"	P
	0	1	0	1	5	7	d	r	;	&	D	R	:
	0	1	1	0	6	6	k	i	q	¢	K	I	Q
	0	1	1	1	7	8	c	a	,	*	C	A	,
	1	0	0	0	8	4	l	o	/	\$	L	O	?
	1	0	0	1	9	0	h	s	y	)	H	S	Y
	1	0	1	0	10	Z				Z			
	1	0	1	1	11	9	b	w	-	(	B	W	_
	1	1	0	0	12								
	1	1	0	1	13		LF	CR	TAB		LF	CR	TAB
	1	1	1	0	14	UC		BS	LC	UC		BS	LC
	1	1	1	1	15	EOT		IDL		EOT		IDL	

Figure 4-5. APL/2741 Mode Character Set Code and Format

series of shift registers. At the end of the timing sequence, the appropriate thirty five dot levels for printing of the characters are available to the print head as well as the 10 required commands to the other printer sections. A strobe pulse, STB-, generated by the character generator and function decoder section is then routed to the timing, print control, and line feed circuitry to initiate the appropriate response.

4-2.3. Print Control. The print control circuitry under the control of the timing circuitry generates a pulse to achieve printing of the character. The pulse length is controlled as a function of the printing speed to ensure even print density. Spacing is also controlled by the print control circuitry. The circuit outputs logic level signals to the motor drive and logic circuit where the necessary power amplification is performed to drive the stepping motor.

4-2.4. Carriage Return. The carriage return circuitry provides control of the carriage motor to accomplish the carriage return. A carriage return is initiated after the eightieth character of a line is printed, when a CR command is decoded by the character generator and function decoder section, or if the local carriage return command is received at the interface connector. Initiation of a carriage return is also performed at power turn on. The automatic carriage return after printing of a line is accomplished by monitoring the print head position using a counter. The counter is incremented or decremented for a space or backspace function to accurately log the position. The counter is also utilized during the return motion of the print head to provide a variable clock rate for the carriage return stepping motor

control circuit. The rate is controlled so that maximum acceleration, movement, and deceleration can be achieved without losing synchronism and thereby ensuring minimum time for this function. When carriage return is initiated for any of the above reasons, the BUSY signal remains high for approximately 30 milliseconds after the carriage has returned to column 1 to allow time for print head settling.

4-2.5. Force Motor. Print head pressure against the paper is controlled by the force motor which is a dual solenoid that pulls the print head against the paper. The carriage return circuitry provides control of this function through the motor drive and logic circuits that produce the required power amplification of the logic level commands. Two windings of the force motor provide different levels of force for a print, carriage return, or line feed operation.

4-2.6. Line Feed. The line feed circuitry controls the line feed stepping motor via the motor drive circuits where power amplification of the logic level signals is performed. Line feed is initiated by a local line feed input at the interface connector, by an input from the carriage return circuitry when the end of a line is reached, by a command input from the character generator and function decoder section, or on power turn on. In addition, the line feed circuitry responds to RF (roll forward) and RB (roll back) commands from the character generator and function decoder section to perform under or over scoring if a character set having those functions is used. Line feed, if commanded, is halted for 30 milliseconds after a carriage return has positioned the carriage to column 1, it continues after this period.

4-3. DETAILED DESCRIPTION

4-3.1 Initialization. The initialization circuit and character generator and function decoder section is shown on sheet 1 of figure 6-1.

The initialization circuit functions to set up the printer for operation once power is applied. Power is routed to the printer through the filtering and regulator section of the printer control board shown on sheet 3. Zener diode CR8, diode CR12 and resistor R46 provide the 14 volt power.

When power is applied, the initialization circuit consisting of R8, C11, C41, CR4 and three sections of inverter 44 shown on sheet 1 produce the INIT and $\overline{\text{INIT}}$ output pulse. The pulse length is determined by the RC time constant of R8 and C11. These pulses, INIT and $\overline{\text{INIT}}$, are distributed to various points to perform the following:

- a. Supply the $\overline{\text{INIT}}$ output at the interface connector.
- b. Set FF8 (pin 5 output) via gate 16 to ensure the character generator and function decoder section is in the quiescent state.
- c. Clock the case flop (FF43) via gate 23 to initialize it to the lower case condition.
- d. Set the mode flop (FF made up of gates 45) to the state for selection of the alternate ROM.
- e. Initiate a carriage return and line feed at the circuits shown on sheet 2 of figure 6-1.

When FF8 (pin 5 output) is set by the $\overline{\text{INIT}}$ pulse via gate 16, the timing circuits for the character generator and function decoder are set to the quiescent state. This is accomplished by applying the resultant logic low at

pin 6 of FF-8 to pin 13 of FF8, the clear input of shift register 17 and the reset inputs of both sections FF9. The $\overline{\text{ONEA}}$ applied to various points is a constant high obtained by a pullup resistor. The high output at pin 8 of FF8 is also routed to the clear input of the row counter which is used as a decade counter. The initial count is thereby set to zero.

4-3.2. Character Generator and Function Decoder. The clock rate for the character generator and function decoder section is a nominal value of 700 KHz produced by R10, C13 and the schmidt trigger gate. This clock output is available at the interface connector via inverter 26 for use at external equipment. With the timing circuit in the quiescent state, the clock applied to pin 11 of FF8 has no affect because it is held reset. The clock is also inhibited at gate 16 pin 3 for the same reason.

To initiate operation of the character generator and function decoder section, a logic high START pulse of at least 5 microseconds is applied. One half of FF8 is then clocked to the reset state, a ROM CLOCK pulse is generated via gate 36 and the ROM clock drivers and shift registers 47 and 27 are cleared. The Q output of FF8 is connected back to gate 45 to inhibit further clocks until it is set at the end of the cycle. The second half of FF8 is then clocked to the set state on the next 700 KHz clock to enable application of the clock to shift register 17. Shift register 17 was loaded with a high in the A position when the clear was removed by clocking FF8 with the start pulse. A load pulse is thereby generated at gate 16 and applied to shift register 47 and counter 46. The five bits of data from the ROM at the address formed by the character input and the zero count of counter 46 and then loaded into shift register 47. At the end of the load pulse, the row counter, counter 46, is clocked to the first count.

At the next clock at shift register 17, the B output is high to set FF9. The Q output enables the shift clock. When the logical one in shift register 17 is shifted to the fifth position, the other section of FF9 is conditioned to be set on the next clock so that a one is again entered into shift register 17. Thus the sequence of pulses is as follows: load, enable the shift clock, and apply a clock to the ROM's. The shift clock is enabled at gate 24 for five clock pulses for each load and ROM clock. Five bits of data are thereby read from the ROM and entered into shift register 47, then shifted to the right 5 places.

After 8 sets of shift pulses and nine ROM clocks, shift registers 47, 27, 15, 6, 14, and 5 are loaded with new data. The row counter, (decade counter) outputs are such as to enable gate 36 to set up for the generation of a strobe (STB-) pulse followed by a reset pulse to return the timing circuit to the quiescent state. The ROM BSY IN signal is a logic low during the same period that the printer busy output is present to prevent the timing sequence described above from being repeated until the printer has fully executed the present character code command. The ROM is thereby addressed nine times for one character code. The ROM is appropriately programmed to provide the right sequence of data to print the character and/or produce the appropriate commands. Selection of the ROM is controlled by the mode FF (gates 45). If the character set in use has the provisions, the S/O and S/I commands can change the mode. Similarly the case flow (FF43) can be controlled. The jumper is connected for the appropriate character sets to change to upper or lower case. The above commands and the RF and RB commands are enabled by the STB- signal at gates 37.

The thirty-five dot level outputs to control the print head are provided by shift registers 15, 6, 14, and 5 and sections of amplifier 25. These outputs are at 0 and +14 volt levels. The three sections of amplifier 25 converts from the TTL levels of shift register 27 to the 0 and 14 volt level.

The STB- output pulse of this section is used to initiate execution of the decoded character code. When the pulse is generated, the dot levels and the various commands are available at the shift register outputs.

4-3.3. Timing Circuitry. The outputs of the character generator and function decoder are utilized by the circuits shown on figure 6-1 sheet 2.

Timing for the circuits is provided by monostable multivibrator 55 which is connected to operate as an oscillator. The oscillator is set to produce an output with a period of 114.5 microseconds within a $\pm 2\%$ range.

The oscillator drives an eight bit counter formed by digital counters 40 and 49 to divide the clock frequency into several components. The reset inputs to the counters are controlled by gate 23. One input to this gate is the STB signal. The other input is an enable provided whenever the busy signal is not present, thus the count is initialized to all zeros when the STB- signal is generated, provided the printer is not busy.

The output of gate 23 is also used to clock both sections of FF13 to store the backspace (BK) and space (SP) commands. The output of gate 23 is also applied to inverter 30 and resistor R31 to produce a delayed STB pulse designated as STB+. The STB+ pulse is used to initiate operation of a cycle. When an operation involving a single space is to be performed, the SP command is present. For this condition, the PRINT CONTROL ROM circuit is enabled.

4-3.4 Print Control Circuitry. The enable for the PRINT CONTROL ROM is applied to pin 15 of ROM 39. To enable the ROM, a logic low must be produced at the $\bar{Q}$ output of FF42. The clock for the FF is provided by gate 11. The STB+ pulse is used to drive the gate and produces the SP START pulse provided a carriage return is not in progress and backspace is not commanded with the carriage in the home (extreme left hand side) position. When the SP START pulse is generated and an SP command is stored in FF13, FF42 is set. Consequently the enable to the PRINT CONTROL ROM is set at a logic low.

The ROM addresses are provided by the counter outputs to produce a sequence of signals for one print cycle. At pin 1 of ROM 39, a low is produced once during the sequence. This output is integrated by C21 to provide the control input to monostable multivibrator 55. The higher the print rate, the lower the voltage on C21 and consequently the pulse length of the multivibrator output is reduced.

At pin 2 of ROM 39, the $\overline{SOL}$ signal is present. This signal is supplied through gate 38 to one of the force motor windings via the power amplifiers. Gate 38 uses an open collector configuration to drive the power amplifier. The $\overline{SOL}$ signal is also used to reset monostable multivibrator 4 in order to energize the other winding of the force motor. Thus, the $\overline{SOL}$ signal produces a maximum force condition for the print head.

Pins 3 and 4 of ROM 39 provide the $\overline{BRAKE}$ and $\overline{CAR CLK}$ signals utilized by the carriage motor STEP CONTROL ROM circuit discussed in following paragraphs. Pin 5 of ROM 39 is set low to produce the CAR COM

signal that increases the supply voltage to the carriage motor from 16 to 24 volts. The voltage is reduced whenever motion is not required to reduce current drawn by the motor. At pin 6 of ROM 39, the $\overline{\text{HOLD}}$ signal is present and is utilized by the force motor control circuits to select the lesser hold solenoid current for movement of the print head after printing occurs. Pin 9 of the ROM produces the trigger input to monostable multivibrator 55. The output pulse drives Q6 which completes the circuit for the print head to print the character. Pulse width is controlled as a function of printing speed and by the ROM output, and is prevented from exceeding 18 milliseconds by C40 and R41.

At pin 7 of ROM 39, the $\overline{\text{EOC}}$ (end of cycle) signal is provided to reset FF42 via gate 20. At that time the enable to ROM 39 is set to a high and consequently all of ROM 39 outputs are set high. Thus the print cycle is terminated. The $\overline{\text{SPACE}}$ and $\overline{\text{SPACE}}$ outputs from FF42 are also returned to their quiescent state. These outputs are utilized by other circuits to denote this condition. This condition is signified at the external equipment by routing the $\overline{\text{SPACE}}$ signal to gate 24. If the paper supply is not exhausted and a line feed is not in progress, the $\overline{\text{ROM BSY IN}}$ is returned to a high to allow the character generator and function decoder section to allow processing of another START command. In addition, if a carriage return is not in progress, gate 23 and inverter 52 function to return the BUSY output to a low. The external equipment is thereby notified that a new command can be processed.

Control of the carriage motor is provided by STEP CONTROL ROM (48), FF54, and gate 51. The motor clock inputs are applied to gate 51 and can be from one of three sources. At pin 9 of gate 51, the clock from the

PRINT CONTROL ROM is applied during the print cycle to move the carriage one space after printing. The clock is provided at pin 11 of gate 51 for execution of a carriage return which will be described in following paragraphs. At pin 10 of gate 51, an external motor clock can be provided from external equipment. The output of gate 51 is applied to the clock inputs of FF54 and to gates 56 which are part of the carriage return circuitry. During power up, $\overline{\text{INIT}}$ resets FF's 54. FF's 54 outputs provide part of the address to ROM 48. The other address inputs are the $\overline{\text{BRAKE}}$ signal, $\overline{\text{BK1}}$, and CR+ signals. With the $\overline{\text{BRAKE}}$ signal low, the ROM output energizes the previous half phase of the carriage motor to allow the print head circuit to stabilize ensuring that smearing does not occur. The $\overline{\text{BK1}}$ (back space 1) is low for execution of a back space command and the CR+ signal is high to execute a carriage return.

These two signals change the ROM outputs at pins 3 and 4. Thus as clocks are applied to FF's 54, the four possible address outputs of the FF's are sequenced so as to provide the $\phi 1$ through $\phi 4$ outputs of the ROM to achieve forward or reverse motion. Each clock input results in one step either forward or backward depending upon the state of the $\overline{\text{BK1}}$ and carriage return signals. One motor phase is normally turned on at a time except during carriage return when CR+ causes two phases to be energized.

4-3.5. Line Feed Circuitry. The line feed circuitry is shown on figure 6-1 sheet 2. A line feed is initiated for four different conditions; by decoding of the LF character set, by applying a local line feed input command from the associated equipment, printing of the eightieth character of a line and at power turn on. When a line feed is decoded at the character generator and function decoder section, only the LF command is high during the STB-

pulse time. The STB-signal is ANDed with LF to produce a low at gate 22 if a Line Feed has been commanded. If a local line feed command is present, the other input to gate 32 is low. A low is thereby generated at the output of gate 32 and applied to gate 29. The other input to gate 29 is the $\overline{\text{EOL+}}$ (end of line) signal which is set low to initiate a line feed at the end of a line and at power turn on. A low at the output of gate 29 then initiates a line feed and is routed through inverter 19 to gate 29. At gate 29, this signal is combined with the output from pin 10 of inverter 19 which is high whenever a line feed is not in progress.

The pulse output of gate 29 toggles the A output of decade counter 10 to a high and provides an inhibit at pin 9 of another section of gate 29 to prevent a reset of the counter. When the A output of the counter is high, the 4 millisecond clock input at pin 1 of gate 29 is enabled. The 4 ms clock is ANDed with $\overline{\text{BCK}}$ or $\overline{\text{CR}}$ to halt the clock if it is the last 30 ms of carriage return. The clock is applied to pin 1 of the counter to cause the B, C, and D outputs to sequence in a BCD count from zero to four with B the LSB. At a count of four, the D output is high and the counter, including the A output, is reset to zero. The clock input is also inhibited at that time. During this count sequence, the line feed is performed. The A output of the counter, LFBSY, is inverted and applied to several points. At gate 24 it is utilized to produce a printer BUSY signal. At gate 29, it inhibits initiation of another line feed. At gate 20, the low produces a low $\overline{\text{LF COM}}$ signal to increase supply voltage to the line feed motor from 12 to 24 volts. And at gate 3, the signal ensures that the print head force is reduced to minimum.

present during the print cycle to accomplish an under or over score. At gate 12 these commands are combined with the SPACE signal that is high during the print cycle. Output of these gates is utilized in the logic determining the motor control signals. The output of these gates also provides a low $\overline{\text{LF COM}}$ signal any time the RF or RB and SPACE signals are high.

The line feed motor control circuits are driven by gates 12 and counter 10 to produce the signals as described by the following equations:

$$\text{LF}\phi 1 = \overline{1 + 2}$$

$$\text{LF}\phi 2 = 1 \cdot \overline{2} + (\text{RF} \cdot \text{SPACE} \cdot \overline{\text{LFBSY}})$$

$$\text{LF}\phi 3 = \overline{2} + 1$$

$$\text{LF}\phi 4 = 2 \cdot 1 + (\text{RB} \cdot \text{SPACE} \cdot \overline{\text{LFBSY}})$$

The numerals refer to the number of pulses counted by counter 10. As can be seen, one count sequence of the counter provides one revolution of the phases. For RF or RB, a partial line feed in the appropriate direction is obtained.

4-3.6. Force Motor. The force motor is controlled by two windings. One winding is the solenoid controlled by the $\overline{\text{SOL}}$ signal output of the print control circuitry previously described and the $\overline{\text{BCK}\phi} + \overline{\text{C/R}}$ signal. The $\overline{\text{BCK}\phi} + \overline{\text{C/R}}$ signal is a composite signal that is low when a carriage return has been initiated and the carriage has returned to column 1 allowing $\overline{\text{BCK}\phi}$ to be low. The signal remains low for 30 milliseconds to allow full solenoid force to dampen carriage oscillations. The other winding is the hold solenoid controlled by the line feed and carriage return circuitry. This circuit consists of monostable multivibrator 4 shown on sheet 2 and the associated gates. One section of multivibrator 4 is triggered by the 4 KHz clock ANDed with HOME+ and the other by $\overline{\text{STB}}$

signal ORed with local C/R. The section triggered by the 4 KHz clock ANDed with HOME+ produces a pulse of approximately 25 microseconds and the other a pulse of approximately 5 seconds. The hold solenoid is energized for the conditions described by the following expression:

$$5 \text{ sec } [(\overline{25 \text{ us}} \cdot \overline{\text{LFBSY}} \cdot \overline{\text{HOLD}} \cdot \overline{\text{C/R}}) + (25 \text{ us} \cdot \overline{\text{LFBSY}} \cdot \overline{\text{HOLD}} \cdot \overline{\text{C/R}})]$$

Since the period of the 4KHz clock is greater than the 25 microsecond pulse, the above describes two average hold solenoid current levels. If the printer is idle more than 5 seconds, no force is applied to the print head. However, if local C/R is pulsed, the five second one shot will again be activated. When printing is initiated via STB+ and the head or paper is to move, the current is applied for the 25 microsecond pulse on time. With no paper or head movement, the current is applied for the 25 microsecond off time. The $\overline{\text{SOL}}$ signal is used to reset the 25 microsecond multivibrator to ensure maximum current in both the solenoid and hold solenoid during printing time. Similarly, HOME+ performs the same function for 30 milliseconds after a carriage return has placed the head at column 1 to dampen oscillations. Therefore, if the printer is idle, the print head has no force exerted on it. When printing is started, some force is exerted when paper or print head motion is to take place and maximum force when printing occurs in order to reduce print cycle time, and when a carriage return has placed the print head at column 1 in order to dampen head oscillation.

4-3.7. Carriage Return Circuitry. The carriage position, or print head, is monitored by decade counters 58 and 57 shown on sheet 2 of figure 6-1. The clock inputs to the counter are pins 4 and 5 of counter 58. Pins 8 and 11 of gates 56 provide either an up or down count clock each time the carriage motor

clock is applied. Assuming a carriage return has been executed and the print head is at the left, the home position sensor provides a low HOME signal via the motor driver board. The HOME signal is inverted and applied to pin 1 of gate 32. The other input to gate 32 is supplied by the STEP CONTROL ROM and is high when the carriage $\phi 1$ is applied which ensures that the motor is fully in the home position. Output of gate 32 is the HOME+ signal which goes to chip 4 pin 9 where it inhibits the 25 microsecond one shot causing full hold solenoid force, and to gate 22 pin 10 where it is anded with the BK1 signal to produce the $\overline{\text{BCK}\phi}$ signal. It is also anded with $\overline{\text{SP}}$ and causes LOAD to go low setting a count of 80 into counters 58 and 57. When HOME+ and BK1 are high, $\overline{\text{BCK}\phi}$ is low to set FF33 (C/R+) and remove the reset of the C/R delay counter. High $\overline{\text{CR}}$ goes to gate 3 where it causes full hold solenoid power and to FF41 releasing the set input of the C/R delay flip-flop. Since $\overline{\text{BCK}\phi}$ and $\overline{\text{C/R}}$ are low, the SOL signal is high and the LF logic will not respond to a LF command. The C/R DLY COUNTER begins counting up at a rate of approximately 2 milliseconds. When it reaches a count of 4, FF41 is reset to return the carriage phase voltage from +24 to +12 volts. At a count of 16 (approximately 30 milliseconds), the carry output goes low resetting FF33 (C/R) and FF13 (BK1) causing $\overline{\text{BCK}\phi}$ to go high. The C/R DLY COUNTER is reset returning the force motor to minimum force and removing the inhibit at the line feed circuitry. The C/R DLY COUNTER is present only on REV "D" and above P. C. Boards.

As the carriage is moved from the home position, an up or down counter clock is applied to the counter by the action of gates 56 and the BK command FF. As described in the print control circuitry, a backspace in the home position is not honored. The first clock to the counter then advances it to

eighty-one. On the eighth count, FF42 is set. After twenty counts, the counter is at zero and gate 31 pin 11 goes high. When the eightieth character is printed, the counter is at 59 and is advanced to 60 after the character is printed. With the count at 60, the B and C outputs of counter 57 are high. These outputs are applied to gate 51. At the next input command to the printer, the backspace FF (13) is set to the correct state and the STB+ pulse is generated shortly after. If a backspace is not ordered, the output of gate 51 is low. The low is inverted and combined with the STB+ pulse to provide a low $\overline{\text{EOL}}$ signal. The $\overline{\text{EOL}}$ signal is anded with $\overline{\text{INIT}}$ to become $\overline{\text{EOL}}+$. A line feed is thus initiated. The $\overline{\text{EOL}}+$ signal resets FF42 and is routed through gate 21 to set FF's 33 and 13.

When FF33 is set, high C/R and low $\overline{\text{C/R}}$ are distributed to various points to inhibit operations and set up for the correct sequence. The low $\overline{\text{C/R}}$ signal is applied to binary counters 1 and 2 to enable them. The clock for counter 2 is provided by gates 50. Since the character count is at 60 initially and FF41 is still reset, the UP clock is applied to counter 2 at a 1/4 millisecond rate. When counter 02 reaches a full count, the output of gate 11 is low since the carry output is low. At the next count, FF33 (C/R+) is clocked to the reset state where a high C/R+ removes the set input to FF43. Since FF43 was previously set, no $\overline{\text{C/R CLOCK}}$ pulse was generated on the first cycle of counter 2.

On the next full count of counter 2, a $\overline{\text{C/R CLOCK}}$ pulse is generated. Counter 2 is also loaded with the output of counter 1 which is initially zero. A clock is also applied through gate 22 to counter 1. The sequence is repeated, each time the motor clocks are spaced closer together because counter 2 count

time is decreased because of the load. When counter 1 reaches a count of 8, FF42 is clocked to the reset state to inhibit clocks to counter 1. The motor clock is then at a 2 millisecond rate and was increased to this rate from 4 milliseconds gradually to allow for inertia of the carriage. Each time the motor clock is applied, counter 58 and 57 is decremented.

When counter 58 and 57 reaches a count of 90, the down count to counter 2 is enabled and the up count is disabled. FF42 is set when the count is 89 to allow clocking of counter 1. The sequence for counters 1 and 2 is then similar to that previously described except counter 1 is counting down. The period between motor clocks is gradually increased from the 2 to 4 millisecond period. On the last count sequence of counters 1 and 2, when the period for motor clocks is 4 milliseconds, FF42 is reset to inhibit clocking of counter 1. The carriage should be at column 1 at the count of 80.

If counter 58 and 57 sequences to a count of 79, gate 28 provides a low to set FF41. When FF41 is set, gate 31 is enabled and gates 50 are disabled. The 4 millisecond clock applied to gate 31 is then routed through to form the C/R CLOCK signal. The 4 millisecond clock then drives the carriage motor until the home position is reached and FF's 33 are set and reset by the home position logic circuit. Counter 58 and 57 is also set to 80 at that time. The above sequence illustrates the events for an end of line condition.

When the carriage return character set is decoded by the character generator and function decoder, a BK command and STB pulse are generated. This contrasts with a single backspace since for that condition, BK, SP and STB pulses are generated. With the SP command absent and the STB pulse present, the BK1 output of FF13 at gate 12 produces a high C/R STB. FF33 is

then clocked to the set state (for end of line it was set directly). The C/R STB signal is also routed through gate 21 to clock FF41. If counter 58 and 57 is between a count of 0 and 60, FF41 remains in the reset state and the sequence for an end-of-line condition is performed. If counter 58 and 57 count is between 80 and 99 inclusive, the carriage return is executed using the fixed 4 millisecond clock. In addition if more than 20 characters have been printed (counter 58 and 57 from 0 to 60), the variable clock rate may not increase to the full 2 milliseconds before the slow down count, the clock rate is reduced from that value down to 4 milliseconds.

A local carriage return is accomplished in manner identical to that above. The only difference is that when a carriage return is initiated, FF33 is directly set rather than being clocked. Additionally for a local or character set carriage return, the line feed is not performed. For the carriage return upon initialization, FF41 is set by the initialize signal routed through gate 28 so that this carriage return is performed at the fixed 4 millisecond rate.

At the end of any carriage return operation, returning FF's 33 to their quiescent state inhibits all C/R CLOCK signals from this circuit by resetting FF41 and holding counters 1 and 2 in the clear state.

Several signals relating to the carriage return function are available at the interface connector for use at associated equipment. These are listed below along with a description of their level and function:

C/R MTR CLK - the clock used for carriage return. Logic low level to denote clock.

LOAD - logic low to indicate the print head is in the home position.

DN CTR - the character counter (58 and 57) down clock. Logic low pulse to denote a clock.

UP CNTR - the character counter (58 and 57) up clock. Logic low to denote a clock.

4-3.8. Motor Drive and Logic. The motor drive and logic circuits are shown on figure 6-2 sheet 1 . The circuits consists simply of power amplifiers and switching circuits including the sixteen volt supply to the paper illumination lamps. In addition, a photo coupler transistor buffer is utilized to condition the home sensor output to TTL compatible levels. A typical motor driver circuit is depicted in figure 4-6.

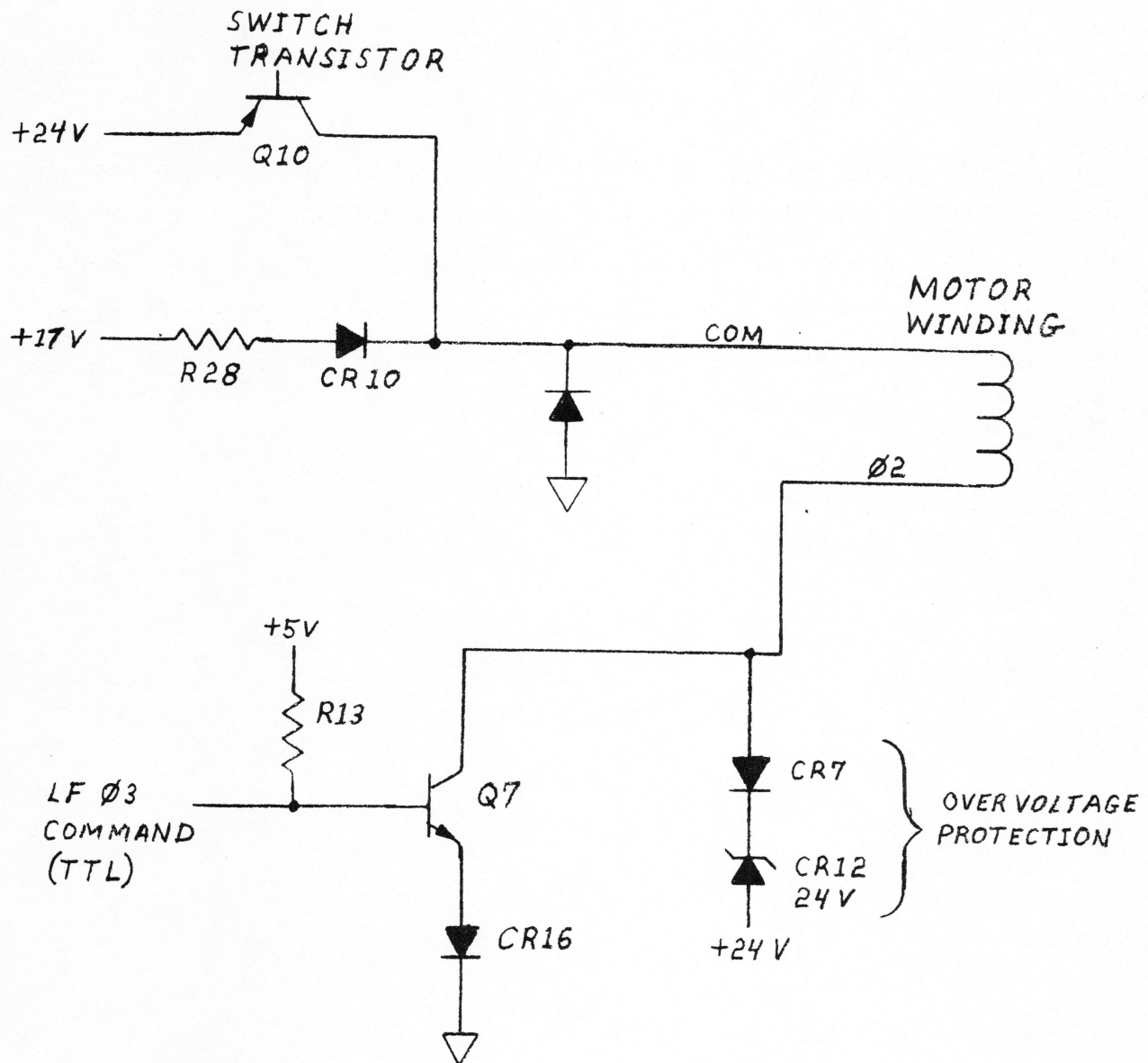


Figure 4-6. Typical Motor Driver Circuit, Simplified Diagram



SECTION 5

PARTS LIST

5-1. INTRODUCTION

Tables 5-1 through 5-3 contain a complete parts list of the CDI-Q3-30 Line printer. Associated with each table are illustrations (Figures 5-1 through 5-5) to assist in identifying and locating replacement parts.

Table 5-1. Printer Assembly Parts List (See Figures 5-1 through 5-3)

Identifying Number	Part Number	Qty.	Description
1	0002-01066	1	FRAME SUB-ASSY
	0002-01065	1	LAMP HOLDER SUB ASSY
	0001-01043	1	ADJUSTMENT RESTRAINING BAR
	0390-00002	3	LAMP 6V (FL8/6R)
2	0002-01056	1	PRINTER CONTROL BOARD (See Table 5-2)
3	0002-01058	1	DRIVER BOARD ASSY (See Table 5-3)
4	0002-01104	1	CARRIAGE ASSY (Available as 3 piece set only)
	0001-01100	1	CARRIAGE SHAFT
	0622-00001	1	LUBRICATING PASTE
5	0002-01075	1	PRINT HEAD SUB ASSY
6	0002-01021	1	OPTICAL SWITCH SUB ASSY.
	0510-00014	1	OPTICAL SWITCH
7	0002-01067	1	PAPER OUT SWITCH SUB ASSY.
	0001-01091	1	SLEEVE
	0510-00012	1	ACTUATOR
	0510-00013	1	SWITCH
	0280-00008	2	SCREW, PAN HEAD

Table 5-1. Printer Assembly Parts List (See Figures 5-1 through 5-3) (Cont)

Identifying Number	Part Number	Qty	Description
	0285-00018	2	HEX, STAND OFF
8	0001-01098	1	MOTOR
9	0001-01170	1	PULLEY
10	0254-00006	1	TIMING BELT
11	0001-01101	1	CARRIAGE TIMING BELT
12	0010-01038	1	FLEX-CABLE ASSY
13	0012-01084	1	FORCE MOTOR, ENCAPSULATED
	0001-01002	1	PAPER EXIT
14	0010-01049	1	PULLEY
	0001-01047	2	CORE MOUNT
	0001-01088	1	DRIVER BOARD MYLAR SHIELD
	0001-01105	1	Q3-30 1st Character Decal
	0210-00053	19	CONTACT RECEPTACLE
	0210-00042	1	CONNECTOR RECEPTACLE
	0210-00054	1	KEYING PLUG
	0281-00024	8	4-40 x 1/4 PHILLIPS SCR, BLK OXIDE
	0281-00003	13	#4 INTERNAL LOCK WASHER
	0281-00006	5	#4 FLAT WASHER

Table 5-1. Printer Assembly Parts List (See Figures 5-1 through 5-3) (Cont)

Identifying Number	Part Number	Qty	Description
	0286-00022	2	4-40 x 3/4 NYLON SCR
	0286-00002	1	#4 NYLON FLAT WASHER
	0286-00028	1	#4 NYLON SHOULDER WASHER
	0281-00020	2	4-40 x 1/8 ALLEN SET SCR, CUP PT
	0281-00007	5	4-40 x 1/4 P. H. SCR
	0282-00016	1	6-32 x 3/16 ALLEN SET SCR, CUP PT
	0286-00035	2	NEOPRENE "O" RING
	0285-00037	1	"E" RING
	0285-00038	1	BOWED "E" RING
	0286-00036	2	RUBBER WASHER
	0286-00038	1	NEOPRENE "O" RING
	0002-01096	1	COATED SCR
	0002-01113	1	COATED SCR

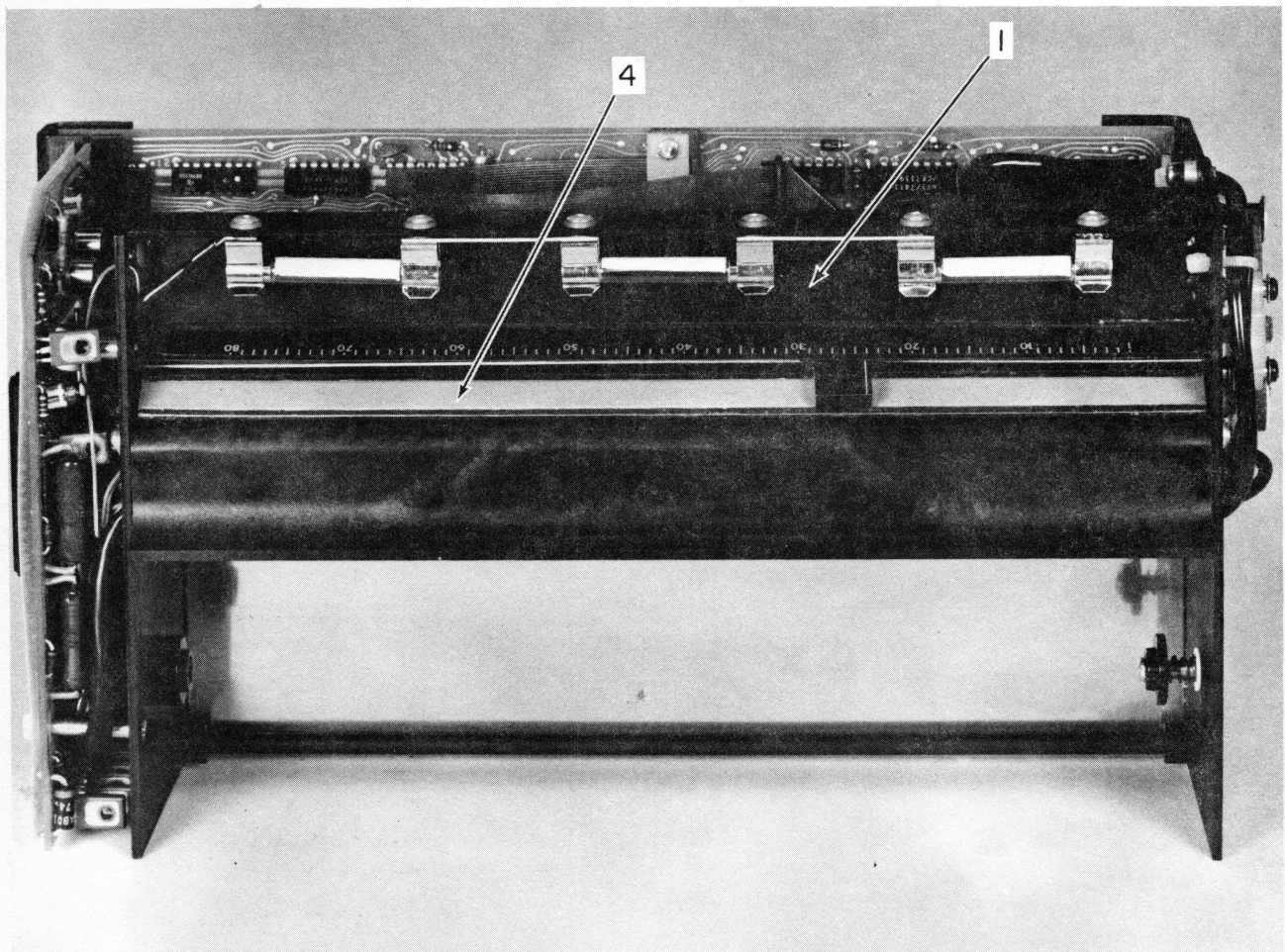


Figure 5-1. Printer Assembly Parts Location, Top View

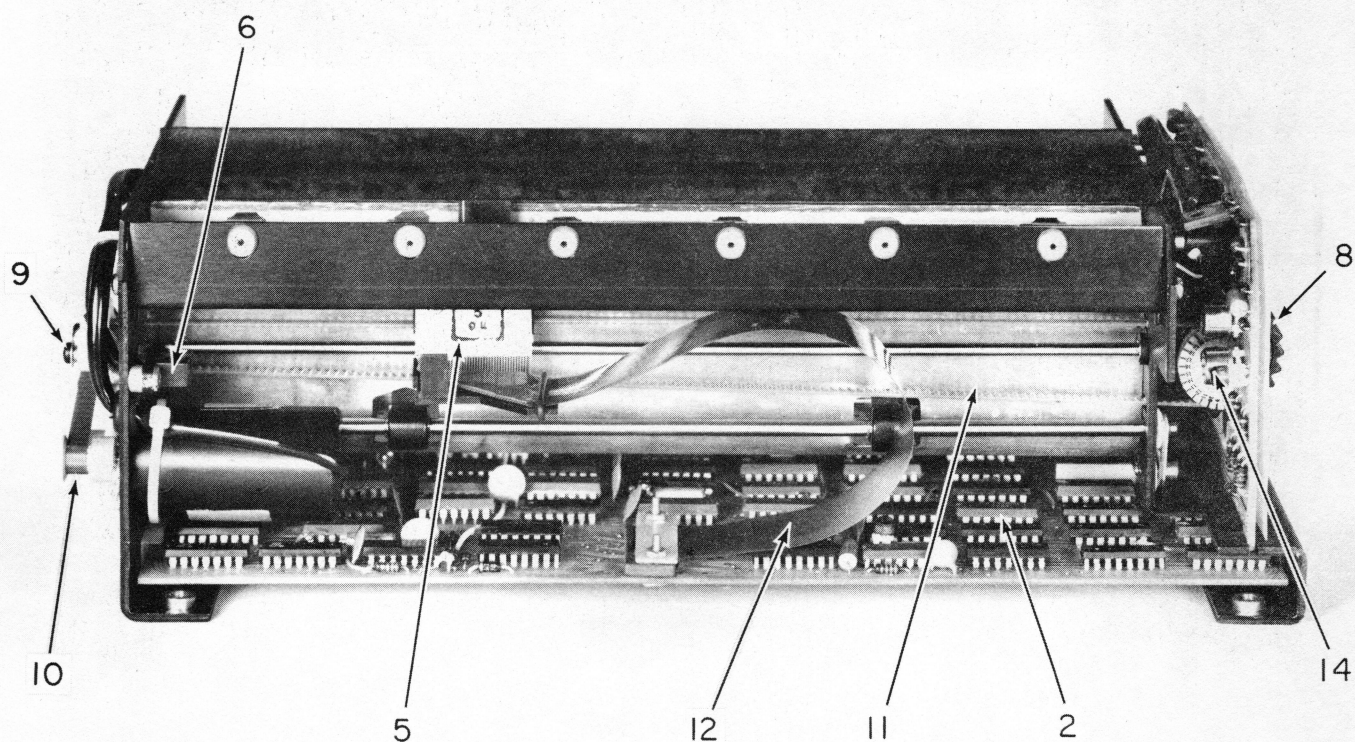


Figure 5-2. Printer Assembly Parts Location, Front View

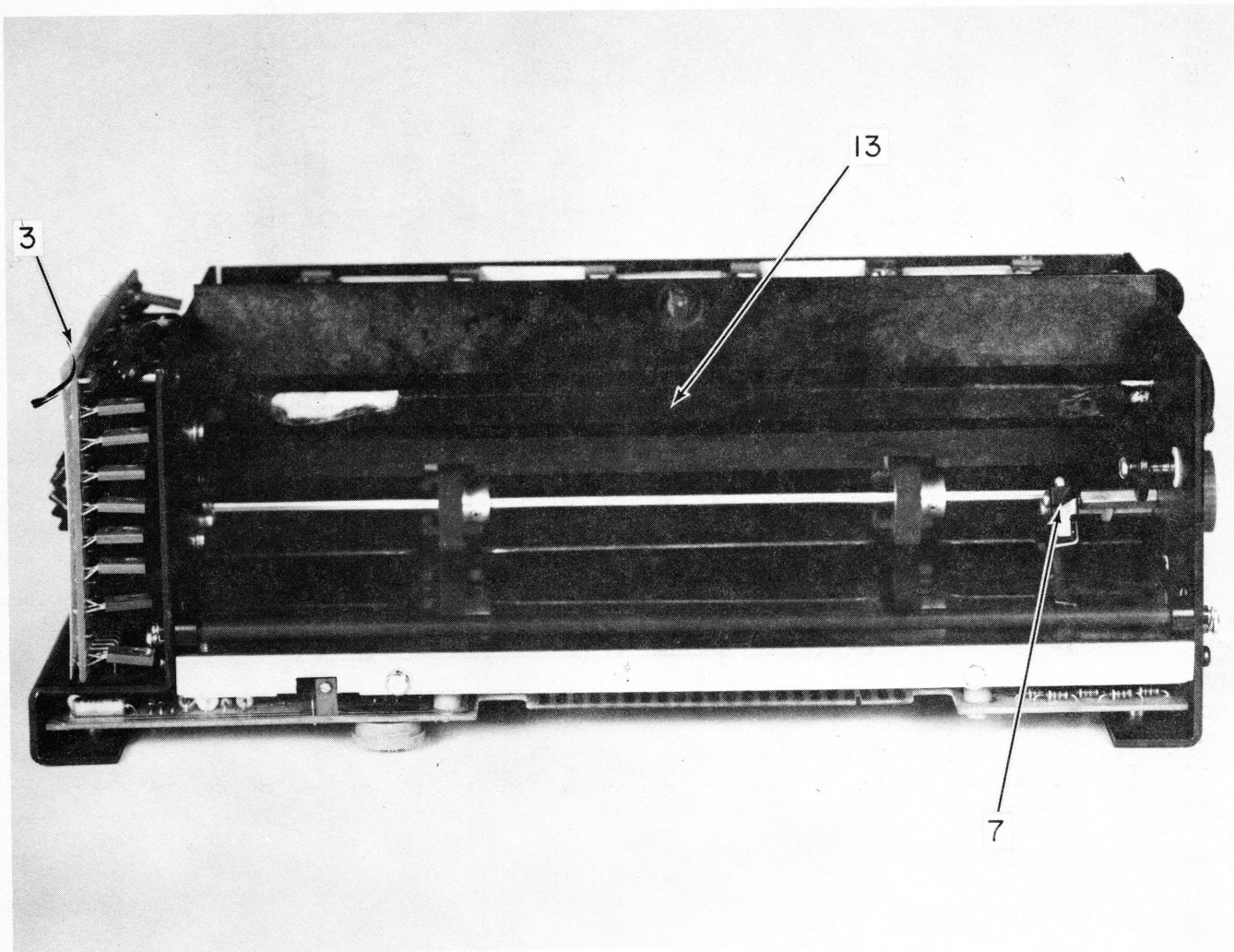


Figure 5-3. Printer Assembly Parts Location, Rear View

Table 5-2. Printer Control Board 02-1106 Parts List (See Figure 5-4)

Part Number	Qty.	Description
0485-00001	7	7400 T2L 2 IN-NAND IC 18, 22, 31, 34, 36, 37, 56
0485-00014	1	7402 T2L 2 IN-NOR IC 21
0485-00002	5	7404 T2L INVERTER IC 19, 26, 30, 44, 52
0485-00034	1	7407 T2L OPEN COLLECTOR H.V. DRIVER IC 25
0485-00011	5	7408 T2L 2 IN-AND IC 16, 20, 23, 29, 32
0485-00012	4	7410 T2L 3 IN-NAND IC 45, 50, 12, 51
0485-00015	2	7411 T2L 3 IN-AND IC 11, 24
0485-00028	1	7413 T2L SCHMIDT TRIGGER IC 7
0485-00032	1	7420 T2L 4 IN-NAND IC 3
0485-00036	1	7433 T2L 2-IN NOR (OPEN COLLECTOR) IC 28
0485-00004	8	7474 T2L D FLOP IC 13, 9, 33, 41, 42, 43, 54, 8
0485-00006	2	7490 T2L DECIMAL CNTR IC 10, 46
0485-00007	3	7493 T2L BINARY CNTR IC 1, 40, 49
0485-00008	2	7496 T2L 5 BIT SHIFT REGISTER IC 17, 47
0485-00018	1	74123 T2L DUAL ONE SHOT IC 4
0485-00013	1	74164 T2L 8 BIT SHIFT REGISTER IC 27
0485-00031	2	74192 T2L DECIMAL UP/DOWN CNTR IC 57, 58
0485-00030	2	74193 T2L BINARY UP/DOWN CNTR IC 2, 35
0484-00005	1	846 DTL 2-IN NAND IC 38

Table 5-2. Printer Control Board 02-1106 Parts List (See Figure 5-4) (Cont)

Part Number	Qty	Description
0012-01051	1	PROGRAMMED PROM IC48
0012-01115	1	PROGRAMMED PROM IC39
OR		
0012-01146 (For type B paper only)		
0485-00027	4	CD4015 CMOS 8 BIT SHIFT REGISTER IC 5, 6, 14, 15
0485-00029	1	556 DUAL TIMER IC 55
0150-00005	2	470 pf $\pm$ 20% 1KV CERAMIC DISC C43, 46
0150-00010	11	0.01 uf $\pm$ 20% 50V CERAMIC DISC C3, 15, 16, 27, 29-34, 37
0150-00019	11	1000 pf $\pm$ 10% 50V CERAMIC (TEMP STABLE) C4-10, 12, 17, 22, 36, 44
0150-00028	1	2200 pf $\pm$ 10% 50V CERAMIC (TEMP STABLE) C13
0150-00016	2	0.1 uf $\pm$ 10% 50V CERAMIC C24, 41
0150-00031	1	0.01 uf $\pm$ 10% 50V CERAMIC NPO C14
0151-00005	1	0.1 uf $\pm$ 10% 250V METAL MYLAR C19
0152-00002	1	1 uf $\pm$ 20% 35V TANTALUM C20
0152-00003	6	4.7 uf $\pm$ 10% 35V TANTALUM C1, 25, 26, 35, 38, 2
0152-00018	1	10 uf $\pm$ 20% 50V TANTALUM C40
0152-00007	3	33 uf $\pm$ 20% 10V TANTALUM C11, 28, 21

Table 5-2. Printer Control Board 02-1106 Parts List (See Figure 5-4) (Cont)

Part Number	Qty	Description
0482-00002	5	1N4148 SILICON SIGNAL DIODE CR 3, 4, 7, 11, 13
0482-00001	2	1N457 SILICON SIGNAL DIODE CR 1, 2
0483-00011	1	1N5234 6.2V ZENER DIODE 1/2W 10% CR6
0483-00005	1	1N4742 12V ZENER DIODE 1W 10% CR5
0483-00013	1	1N4743 13V ZENER DIODE 1W 10% CR8
0483-00012	1	1N4746 18V ZENER DIODE 1W 10% CR14
0482-00007	1	1N4002 SILICON POWER DIODE CR12
0480-00003	1	2N3565 NPN SIGNAL TRANS Q7
0480-00008	4	2N4916 PNP SIGNAL TRANS Q1-4
0480-00020	1	MJE800 NPN POWER TRANS Q6
0470-00013	1	10 Ω 1/4W 5% CARBON RESISTOR R6
0470-00028	1	47 Ω 1/4W 5% CARBON RESISTOR R46
0470-00040	1	150 Ω 1/4W 5% CARBON RESISTOR
0470-00047	2	300 Ω 1/3W 5% CARBON RESISTOR R2, 7
0470-00048	4	330 Ω 1/4W 5% CARBON RESISTOR R31, 32, 33, 35
0470-00052	3	470 Ω 1/4W 5% CARBON RESISTOR R9, 40, 41
0470-00056	1	680 Ω 1/4W 5% CARBON RESISTOR R10

Table 5-2. Printer Control Board 02-1106 Parts List (See Figure 5-4) (Cont)

Part Number	Qty	Description
0470-00060	2	1K Ω 1/4W 5% CARBON RESISTOR R26, R13
0470-00066	2	1.8K Ω 1/4W 5% CARBON RESISTOR R3, 45
0470-00074	1	3.9K Ω 1/4W 5% CARBON RESISTOR R37
0470-00075	1	4.3K Ω 1/4W 5% CARBON RESISTOR R59
0470-00076	14	4.7K Ω 1/4W 5% CARBON RESISTOR R18-25, 27, 28, 29, 64, 65, 12
0470-00079	1	6.2K Ω 1/4W 5% CARBON RESISTOR R36
0470-00082	1	8.2K Ω 1/4W 5% CARBON RESISTOR R60
0470-00084	3	10K Ω 1/4W 5% CARBON RESISTOR R42, 70, TH1
0470-00096	3	33K Ω 1/4W 5% CARBON RESISTOR R62, 63, 8
0476-00002	1	1.0K Ω RESISTOR NETWORK R11
0476-00001	2	4.7K Ω RESISTOR NETWORK R51, R43
0470-00144	1	3.3m Ω 1/4W 5% CARBON RESISTOR R61
0474-00021	1	150 Ω 3W WIRE WOUND RESISTOR R1
0473-00004	2	470 Ω 1W WIRE WOUND RESISTOR R4, 5
0470-00023	1	30 Ω 1/4W 5% CARBON RESISTOR R69
0471-00005	1	6.19K Ω 1% METAL FILM RN55 1/8W R47
0475-00008	1	20K Ω 1 TURN TRIM POT R38
0475-00007	1	100K Ω 10 TURN TRIM POT R50

Table 5-2. Printer Control Board 02-1106 Parts List (See Figure 5-4) (Cont)

Part Number	Qty	Description
0210-00041	1	CONNECTOR ASSY VERTICAL
0210-00038	2	24 PIN I/C SOCKET (LOW PROFILE)
0004-01106	1	PC BOARD
0210-00037	2	16 PIN I/C SOCKET (LOW PROFILE)
0520-00003	5	TO-18 MTG. SPACER (TRANSIPAD)
0280-00010	2	NUT 2-56
0001-01090	1	FLEX CABLE RESTRAINER
CONFIGURATION ROM REQUIREMENTS		
0006-00215	REF	FOR 63 ASCII PRINTER A0002-01114 CHARACTER GENERATOR IC58
0006-00216	REF	FOR APL/A PRINTER A0002-01108 CHARACTER GENERATOR IC58
0006-00211	REF	FOR APL/B PRINTER A0002-01109 CHARACTER GENERATOR IC58
0006-00215	REF	FOR APL/ASCII PRINTER A0002-01112 CHARACTER GENERATOR IC58
0006-00216	REF	CHARACTER GENERATOR IC59

Table 5-2. Printer Control Board 02-1106 Parts List (See Figure 5-4) (Cont)

Part Number	Qty	Description
-		FOR APL/2741 PRINTER A0002-01111
0006-00253	REF	CHARACTER GENERATOR IC59
0006-00254	REF	CHARACTER GENERATOR IC58
-		FOR KATAKANA PRINTER A0002-01110
0006-00467	REF	CHARACTER GENERATOR IC 59
0006-00532	REF	CHARACTER GENERATOR IC58
		FOR 68/ASCII PRINTER A0002-01113
0006-00539	REF	CHARACTER GENERATOR IC58

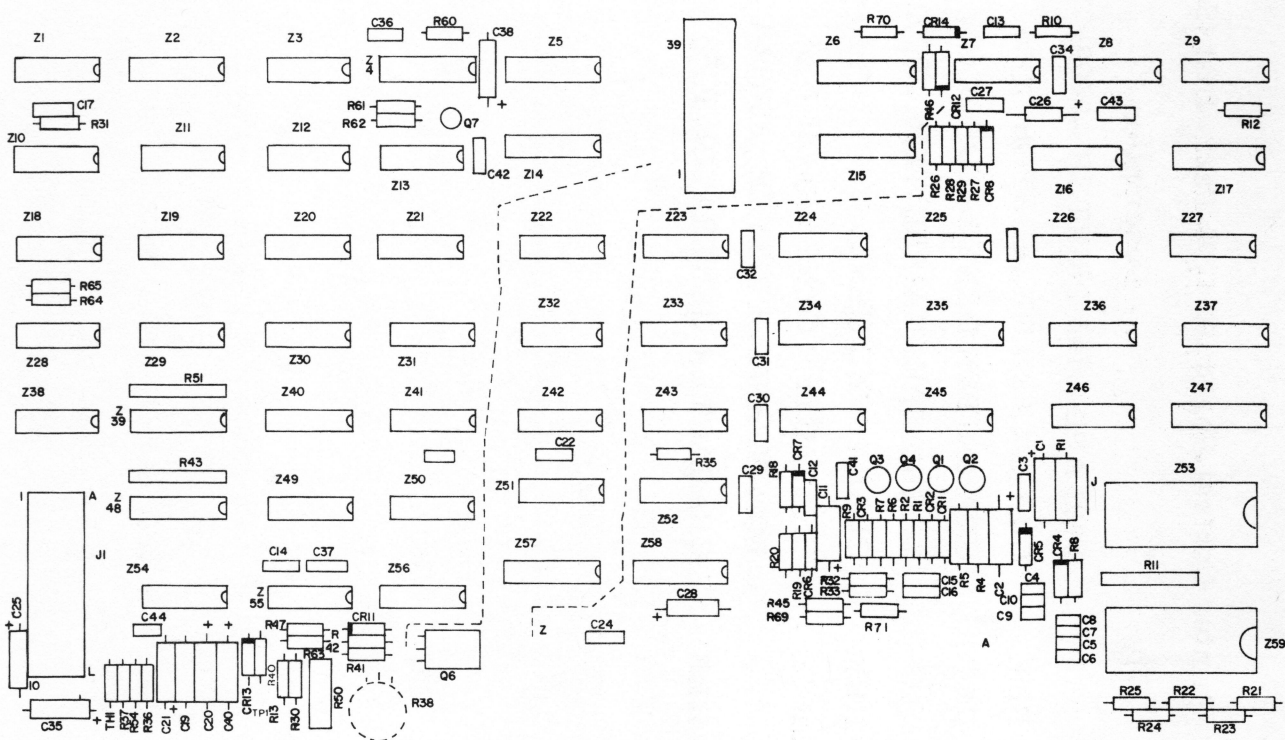


Figure 5-4. Printer Control Board 02-1106 Parts Location

Table 5-3. Driver Board 02-1058 Parts List (See Figure 5-5)

Part Number	Qty	Description
0470-00040	1	150 Ω 1/4W 5% CARBON COMP RESISTOR R23
0470-00072	1	3.3K Ω 1/4W 5% CARBON COMP RESISTOR R24
0470-00060	12	1K Ω 1/4W 5% CARBON COMP RESISTOR R1, 3, 5, 7, 9, 11, 13, 15, 26, 29, 30, 34
0470-00076	3	4.7K Ω 1/4W 5% CARBON COMP RESISTOR R17, 19, 25
0470-00084	5	10K Ω 1/4W 5% CARBON COMP RESISTOR R35, 18, 20, 37, 38
0474-00007	2	15 Ω 5 WATT WIRE WOUND RESISTOR R27, 28
0470-00023	2	30 Ω 1/4W 5% CARBON COMP RESISTOR R31, 32
0152-00016	1	6.8 uf 35V TANTALUM CAPACITOR 20% C6
0150-00011	1	0.001 uf CERAMIC CAPACITOR C1
0150-00010	3	0.01 uf CERAMIC CAPACITOR C2, 3, 4
0151-00005	1	0.1 uf 50V METAL MYLAR CAPACITOR C5
0470-00052	3	470 Ω 1/4W 5% CARBON COMP RESISTOR R39, 33, 36
0482-00007	12	1N4002 POWER DIODE 1 AMP 100V CR1-10, 18, 19
0482-00005	2	RAB010 POWER DIODE 3 AMP 100V CR15, 16
0482-00002	1	1N4148 SIGNAL DIODE CR13
0483-00010	1	1N4749 ZENER DIODE 24V, 1 WATT CR12
0482-00001	1	1N457 SIGNAL DIODE CR17
0480-00021	1	MJE700 PNP POWER TRANSISTOR Q9, 10
0480-00020	8	MJE800 NPN POWER TRANSISTOR Q1-8
0480-00003	4	2N3565 NPN SIGNAL TRANSISTOR Q12, 15, 16, 17

Table 5-3. Driver Board 02-1058 Parts List (See Figure 5-5) (Cont)

Part Number	Qty	Description
0480-00023	2	2N3439 NPN SIGNAL TRANSISTOR Q11, 13
0210-00053	1	1-86415-3 RT. ANGLE HEADER ASSY P1
0210-00040	20	86091-4 POST MTD. IN POLYETHYLENE STRIP DUAL ROW P2
0004-01058	1	PC BOARD 1
0482-00004	1	1N4004 POWER DIODE 1 AMP 400V CR11, 14
0520-00003	4	TO-18 TRANSIPAD
0520-00004	2	TO-5 TRANSIPAD

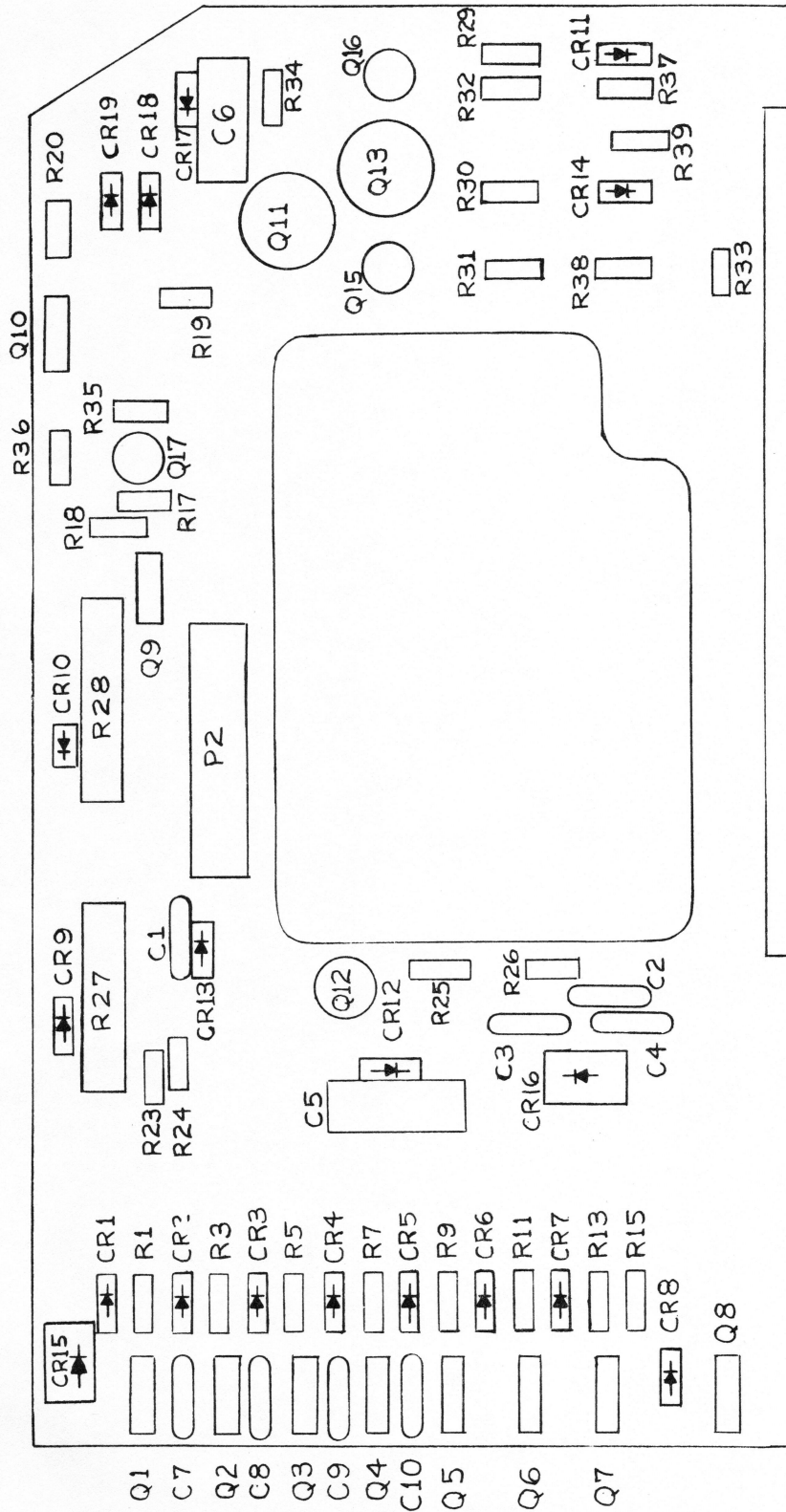


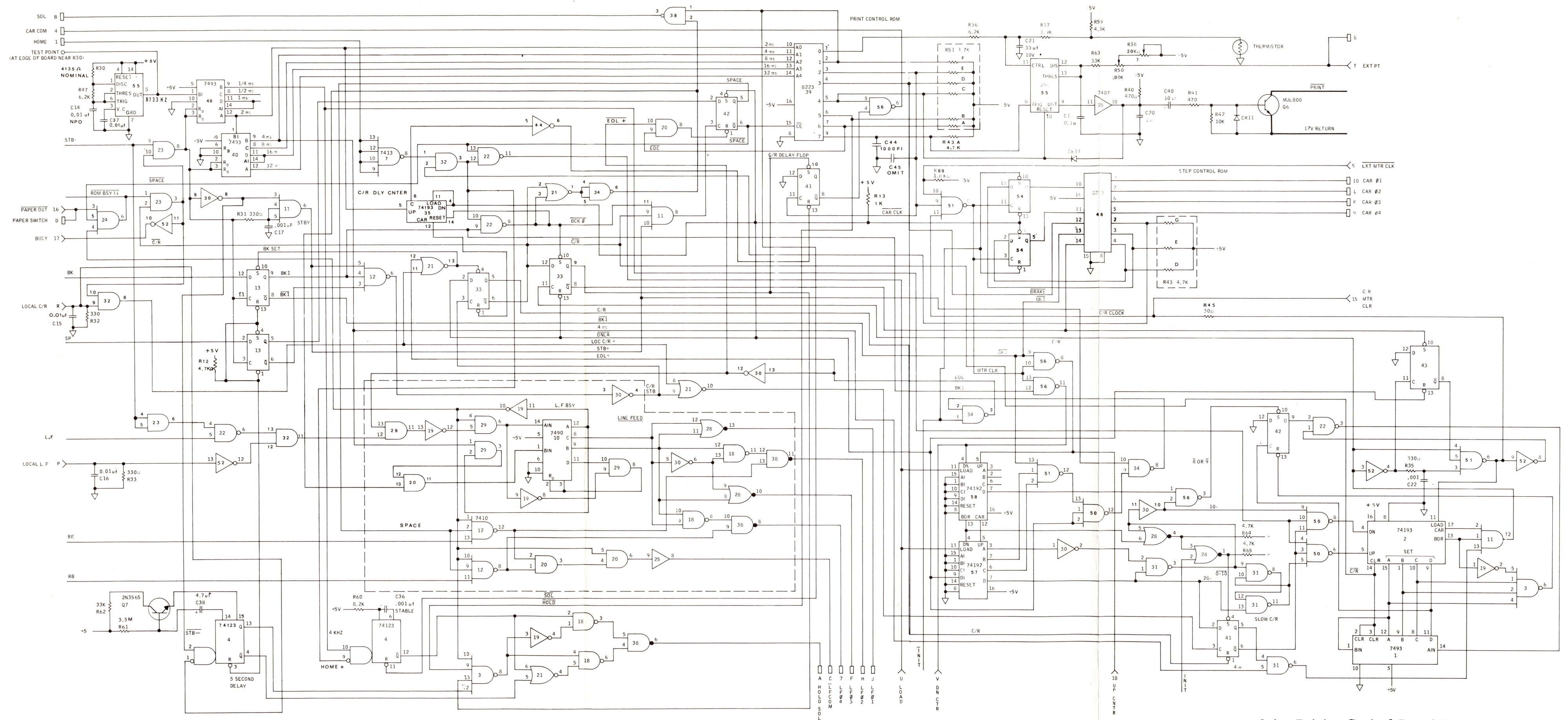
Figure 5- 5. Driver Board 02-1058 Parts Location

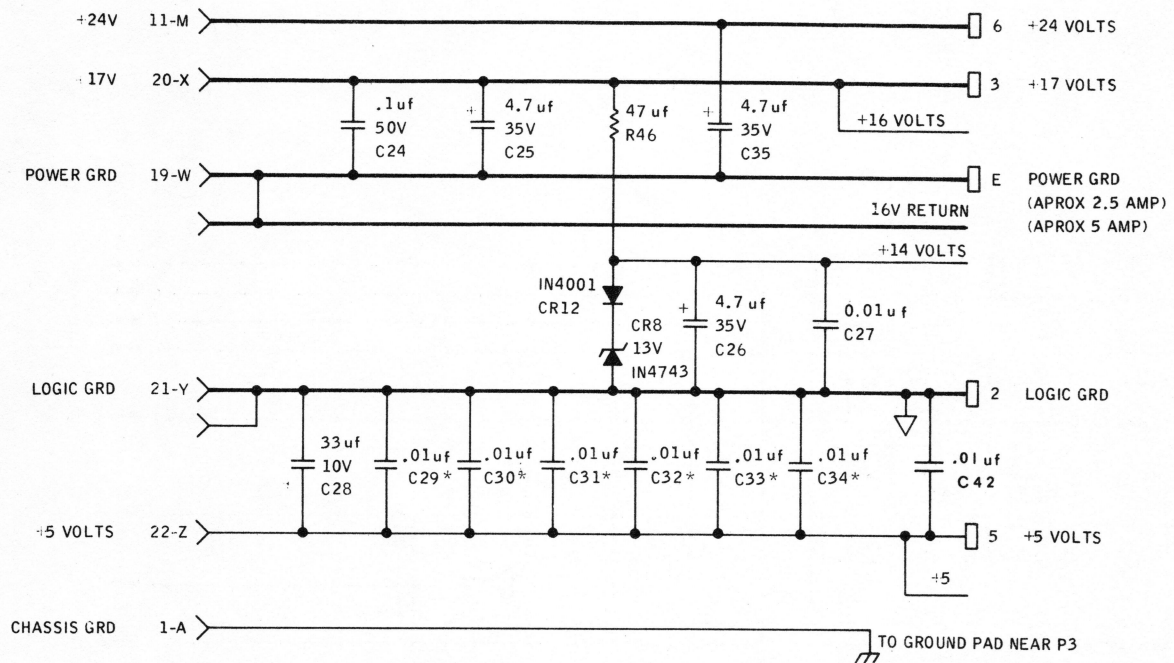
SECTION 6

SCHEMATICS

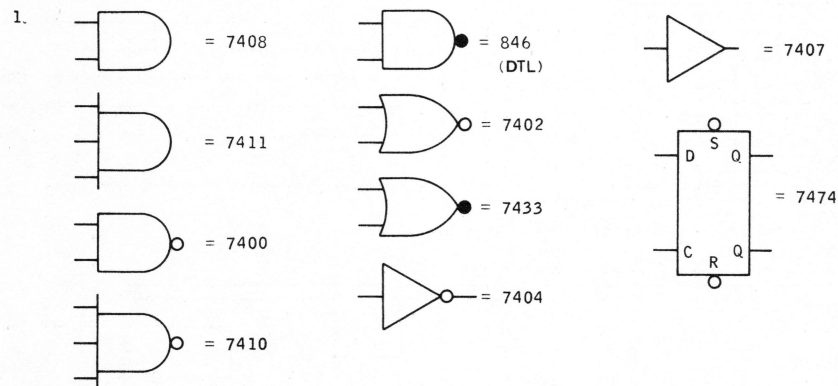
6-1. INTRODUCTION

6-2. This section contains schematic diagrams of the printer control board and driver board.





NOTES:



2. ALL RESISTORS 1/4 W 5% UNLESS SPECIFIED
3. * DISTRIBUTE EVENLY ACROSS BOARD
4. = CARD EDGE CONNECTOR (P3)
- = J1
- = PRINT HEAD CONNECTOR (J4)
5. = IN4148
6. = HEAVY RUN TO CARRY 3 AMP MIN.
7. = TEST POINT

Figure 6-1. Printer Control Board Schematic Diagram
(Sheet 3 of 3)

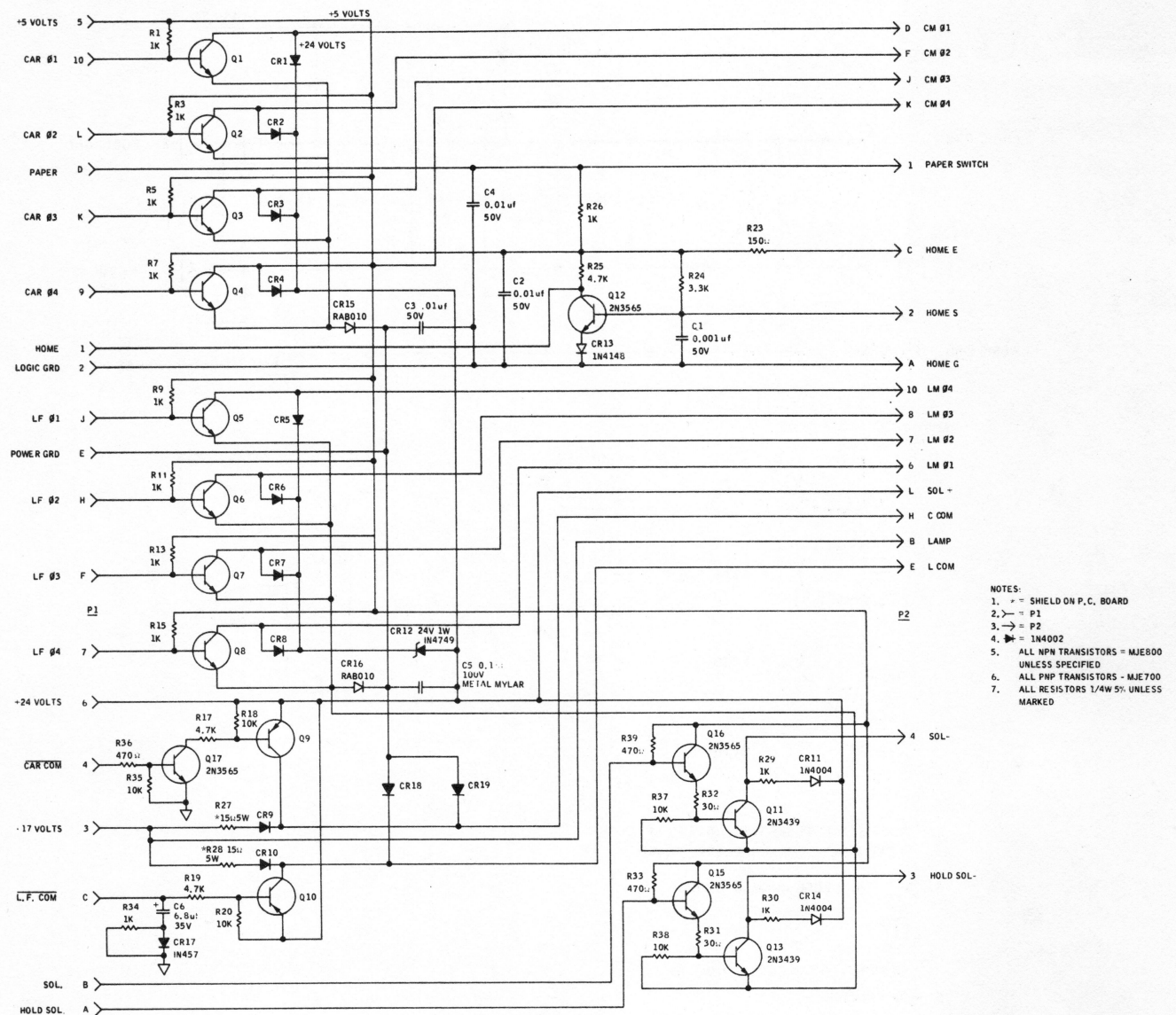


Figure 6-2. Driver Board Schematic Diagram

